AVIATION WEEK

APR. 25, 1955

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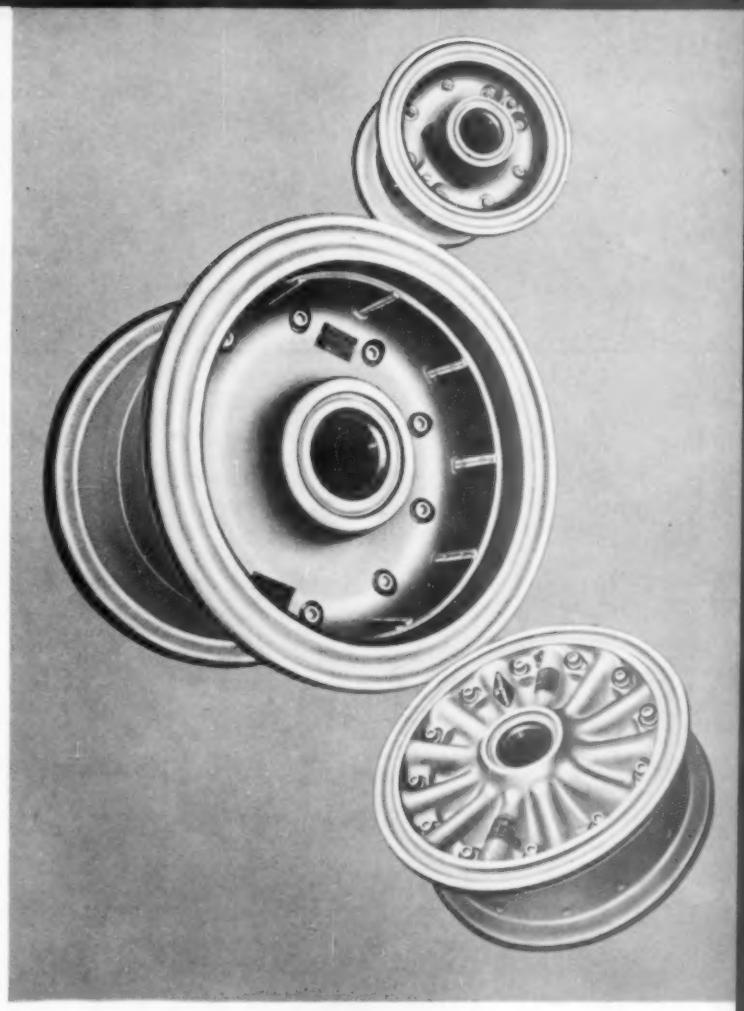
50 CENTS

Forging ahead

IN PERFORMANCE

per-pound-of-wheel
per-pound-of-load
per-roll-mile



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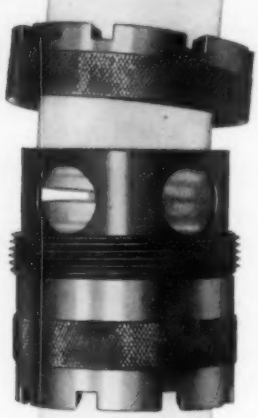
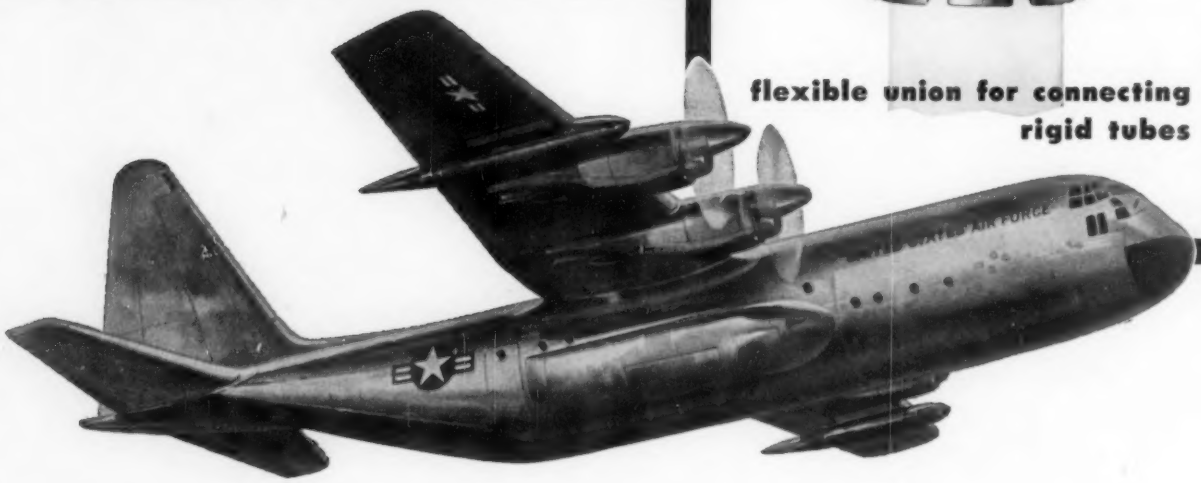
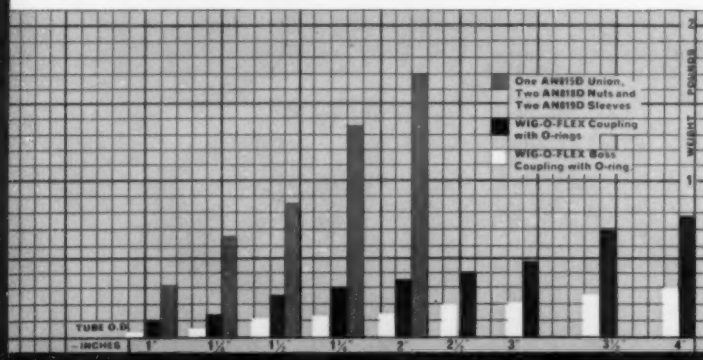


flexible union for connecting rigid tubes





WEIGHT COMPARISON CHART
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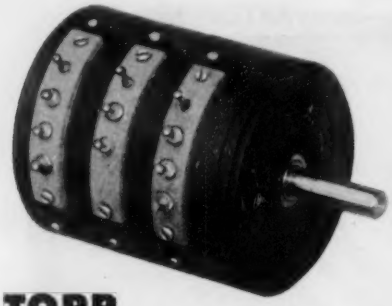

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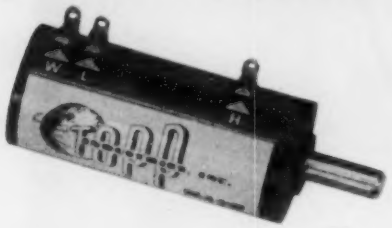

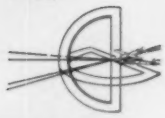

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Table of Contents on Page 8

55,658 copies of this issue printed

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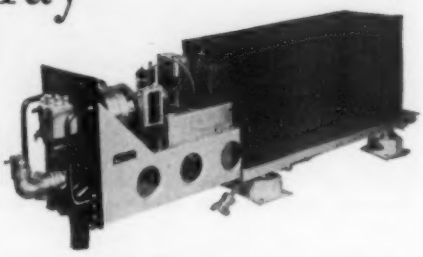

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NEWS DIGEST

Domestic

Bell Aircraft Corp. is building a prototype of a new high-speed reconnaissance plane at its plant in Niagara Falls, N. Y. The highly classified project for USAF is the first Bell contract for a combat aircraft since World War II.

House Armed Services Investigating Subcommittee is trying to find out why USAF negotiated a $3.6-million contract for rocket launchers with Century Industries Corp. of San Pedro, Calif., whose performance on a Navy order was unsatisfactory. Also involved in the investigation is why the Air Force failed to give Radiant Manufacturing Co., Chicago, and Cincinnati Industrial Finishing Co., both with satisfactory performance records, a chance to bid on the contract.

Wage strike was called against Sperry Gyroscope Co.'s Lake Success, N. Y., plant last week by the International Union of Electrical Workers (CIO). About 9,500 workers staged the walkout after the avionic manufacturer turned down the union's demand for an immediate increase of 18 cents an hour plus welfare benefits. Sperry offered a 12.2-cent package agreement spread over three years.

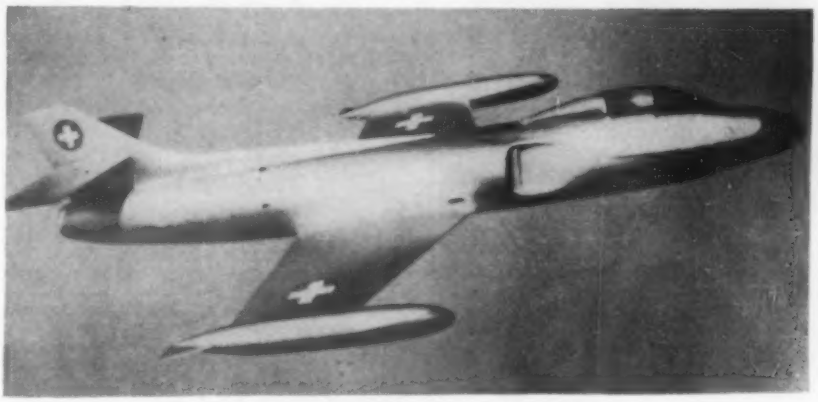
Mohawk Airlines sold its eight-passenger Sikorsky S-55 copter to Canada's Okanagan Helicopters, Ltd. After dropping experimental rotorcraft service (see p. 16).

B-36 simulator is training crews at Strategic Air Command's Carswell AFB under a schedule calling for 17 hr. 15 min. a day, one of the highest utilization figures reported by USAF for this type of equipment. The simulator was developed by Curtiss-Wright Corp.'s Electronics Division.

Rudolph F. Gagg resigned as special assistant to Roger Lewis, Air Force Assistant Secretary for Materiel, to return to Bendix Aviation Corp.

John H. Higman, 29, engineer at Grumman Aircraft Engineering Corp., died Apr. 17 in New York.

Merger proposal between Eastern Air Lines and Colonial Airlines was approved by CAL stockholders last week. The vote by shares: 344,303 for 5,470 against. The merger agreement still must be approved by Civil Aeronautics Board.



Swiss P-16 Nears Tests

Switzerland's new P-16 is shown in this artist's drawing of the short-field fighter. Designed to operate from small bases in rugged terrain, the heavily armed P-16 will replace Venoms and Vampires flown by Swiss Air Force. Two prototypes are being built by Glug & Fahrzeugwerke A.G. and will begin ground tests soon.

DME shipments were resumed by National Aeronautical Radio Corp., following Air Coordinating Committee's decision to extend VOR/DME development for the common system until 1960 (see p. 114).

Turboprop Boeing YC-97J Stratofreighter, powered by Pratt & Whitney T34 engines (see p. 16), made its first flight last week at Seattle. The transport's four engines give 5,700 hp. each, compared with 3,500 hp. in the piston-engine version.

National Airlines received temporary authorization for helicopter service within a 100-mile radius of Newport News, Va. The service, approved for one year, is restricted to Norfolk-Newport News-Richmond service and will be operated without subsidy.

Financial

Douglas Aircraft Co., Santa Monica, Calif., had a net profit of $7,110,000 for the fiscal quarter ended Feb. 28, dropping from $8,899,000 for the same period last year. Sales totaled $214,824,000, compared with $240,867,000. Backlog Feb. 28: $1,892 million, declining from $2,035 million at the close of Fiscal 1954.

Republic Aviation Corp., Farmingdale, N. Y., had net profits of $3,861,000 for the first quarter of 1955, increasing sharply from $925,000 for the first three months of last year. Sales were $124,131,000, againt $44,255,000.

Chance Vought Aircraft, Inc., Dallas, reports net income of $701,984 for the quarter ended Mar. 31, declining from $1,293,000 for the same period last year. Sales dropped to $26,919,000 from $35,329,000. Backlog Mar. 31: $193 million, compared with $188 million at the start of 1955.

American Airlines reports net earnings of $2,483,000 in the first quarter, compared with $746,000 in the same period of 1954. Revenues increased from $49,942,000 in first quarter 1954 to $56,754,000 in 1955.

International

Russian-built IL-28 twin-jet bombers are based in Communist China near the Shanghai-Hangchow-Ningpo complex, according to reports from Taipei. Estimates of the number of IL-28s, flown in from former bases in Manchuria and North China, ranges from 30 to "somewhat less than 100."

Maj. Frank B. Halford, 61, chairman and technical director of de Havilland Engine Co., pioneer in turbojet development, designer of the Goblin, Gipsy, Ghost and Gyron powerplants and pilot instructor before World War 1, died Apr. 17 in London.

Trans-Canada Air Lines ordered three more Viscounts from Vickers-Armstrongs, bringing the number of turboprop-powered transports purchased by TCA to 25. Cost of the three Viscounts plus spares: more than $2.8 million. The airline also ordered two Super-G Constellations from Lockheed Aircraft Corp.

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The Aviation Week

April 25, 1955

Special Report

SAE Holds Aeronautic Meeting..... 15

Headline News

USAF Seeks A-Engine Lab Funds..... 18
Security Cloaks F-104 Crash..... 18
SEC Lists Stock Transactions..... 23

Aeronautical Engineering

F-102A's Supersonic Shape..... 14
Avco Forms Air Weapons Group..... 23
Engineer-Doctor Team Aids Pilots..... 31
Thinner Wing to Raise X-1 Speed..... 42
Flying Platforms are NACA Payoff..... 44

Production

New Plan Threatens Incentive Pay..... 12
"Fair" Subcontracts for Small Firms... 18
How Marquardt Backs Up Ramjets..... 53

Avionics

How Sun Could Drive Spaceship..... 76
New Avionic Diode Simplifies Design.. 82
Avionic Industry Expansions..... 84
Filter Center 89

Equipment

New Jets Get Ratio Thrust Indicators.. 69
New Aviation Products..... 72
Also on the Market..... 74

Air Transport

Big Air Transport Advance Is Seen.... 21
New High For Summer Air Traffic....111
CAB Airworthiness Agenda.....112
ACC Adopts Tacan Compromise.....114
EAL, Braniff Get Interchange.....114
Airline Salaries, Bonuses.....117
Court Studies Pilot Immunity Case....118
CAB Orders 118

Financial

Aircraft Profit Rise Best in U. S..... 92

Editorial

A Good Start.....122
Is Aviation Necessary?.....122
UAC's Statesmanship 122

Departments

News Digest 7
Who's Where 9
Industry Observer 9
Washington Roundup 11
USAF Contracts 60
Navy Contracts 67
Aviation Calendar 90

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WHO'S WHERE

(These personnel changes in the aviation industry were announced:)

In the Front Office

Dr. Charles L. Critchfield, director of scientific research, Convair Division, General Dynamics Corp., San Diego.

Helen Peterson, executive corporate secretary, North American Airlines, Inc.; **Herbert Kielson,** national passenger service director and regional manager; **Harold Cope,** national operations director, and **O. V. Cash,** southwestern region manager.

Fred E. Harrell, president, Marquette Metal Products Co., Cleveland.

William A. Roth, vice president and assistant general manager, Cleveland Pneumatic Tool Co., Cleveland.

Arthur E. Raabe, to the corporation staff, Bendix Aviation Corp., Detroit. **Roy H. Isaacs,** general manager, **Milo F. McCammon,** assistant general manager and **Charles A. Wolf,** director of sales and service, Eclipse Pioneer Division, Teterboro, N. J. **Wendell E. Eldred,** engineering manager, landing gear products, Bendix Products Division, South Bend, Ind.

James R. Williams, special assistant to the president, Allegheny Airlines. **Robert C. Schumm,** director of stations.

Changes

R. B. Blythe, assistant to the vice president, Aro Equipment Corp., Bryan, Ohio. **D. W. Orrick,** aircraft products sales manager.

Benjamin S. Collins, chief development engineer, Plastics Division, Nopco Chemical Co., Harrison, N. J.

S. E. Connair, Jr., midwest customer service, Ryan Aeronautical Co., San Diego. **A. Herbert Stone, Jr.,** liaison coordinator and **Clarence E. Haas,** field service representative.

H. P. Bish, manager of market planning and development, Marketing Planning & Development Section, Aviation & Defense Industries sales department, General Electric Co., Schenectady, N. Y. Other new managers in this department: **J. C. Wheeler,** contract procedures; **R. A. Averitt,** aviation systems engineering; **W. E. Jacobsen,** marine application engineering; **J. P. Turner, Jr.,** central district; **R. M. Fritz,** northeast district; **W. F. Cronin,** northwest district; **R. E. Johnson,** southeast district; **J. E. Schwartz,** southwest district and **E. S. Thompson,** western district.

Joseph C. Johnson, manager of research and development, Titeflex, Inc., Newark, N. J.

Robert R. Lent, Washington, D. C., representative, Reaction Motors, Inc., Rockaway, N. J.

W. L. Wilkinson, sales manager, W. C. Twigg Industries, Inc., Brazil, Ind.

Honors and Elections

Raymond G. Lochiel, vice president-comptroller-treasurer, Capital Airlines, became a director of Controllers Institute of America.

INDUSTRY OBSERVER

► **Chance Vought XF8U-1 hit supersonic speed on its first flight at Edwards AFB, Cal., and is expected to surpass the unofficial Mach 1.38 mark set by North American's F-100 at altitude. Plane is of conventional layout with its sweptback wing mounted high on the fuselage to give clearance for the two-position, variable-incidence surface. Powerplant is a Pratt & Whitney J57 turbojet.**

► Pratt & Whitney Aircraft J75 split compressor turbojet has made its initial tests rigged in the bomb bay of a North American B-45. P&WA is flight testing the 15,000-lb. thrust J75 at Rentschler Airport in East Hartford, Conn.

► **Trans-Australia Airlines reports a load factor of 85.7% for its fleet of four Vickers Viscount turboprop transports for the first three months of regular passenger service. Total of 4,078 passengers were carried. Average daily aircraft utilization was 11-hr.**

► Republic Aviation Corp. F-105 fighter-bomber will be powered in early versions by the Pratt & Whitney J57 turbojet with a switch to the J75 when it becomes available. USAF had originally scheduled the Allison J71 for this aircraft.

► **McDonnell Aircraft Corp.'s XV-1 convertiplane may make its first conversion from vertical to horizontal flight this week. Transcendental Aircraft's convertiplane also is near conversion flight stage.**

► British Vulcan four-engine delta-wing jet bombers may be built in Canada as a result of discussions now understood to be underway at Ottawa, London and Washington, D. C. Avro Aircraft Ltd.'s Toronto, plant, subsidiary of A. V. Roe Aircraft Ltd., of England, would build the planes, and the Rolls-Royce Canada Ltd. plant at Montreal, would build the Avon engines now used in the British-built Vulcans.

► **Canadair Ltd., a subsidiary of General Dynamics Corp., has built approximately 1,300 F-86 Sabres under license from North American Aviation and more than 500 T-33 jet trainers under license from Lockheed. Canadair Sabres are in use with USAF, Britain's RAF and the Greek and Turkish air forces in addition to the RCAF.**

► Civil Aeronautics Administration issued a commercial-type certificate for Pratt & Whitney's J57, 10,000-lb. thrust jet engine. Request for civil certification was made by Pratt & Whitney.

► **Lockheed's first production C-130A turboprop transport suffered extensive damage when fire broke out in the area of No. 2 nacelle after a normal landing from a routine two-hour test flight. Fire damaged the left wing, left side of fuselage and No. 2 engine nacelle.**

► Red sources have finally credited Russian designer Ilyushin with a new swept-wing bomber designated IL-28-2 (AW Sept. 28, 1953, p. 10). The East German newspaper "Forum" says the light bomber reaches a speed of 621 mph., and is now in production.

► **Grumman Aircraft's Tiger, supersonic lightweight Navy fighter, has been re-designated the F11F-1. Former designation was F9F-9.**

► Dassault Mystere IV B.1, the Super Mystere, has made several test flights at supersonic speeds and reached an altitude of 52,500 ft. The interceptor is powered by an Avon RA.7 engine with afterburner.

► **Current thrust rating of Pratt & Whitney's J57—14,500 lb. with afterburner—could be increased to 17,000 lb. without much difficulty, engineers believe. They feel that further development of the engine could produce 20,000 lb. thrust rating with the same frame as the current J57.**

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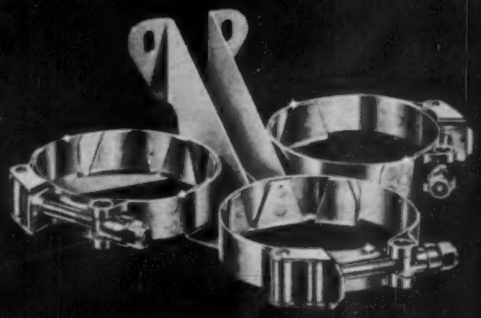

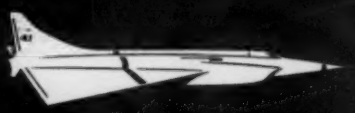

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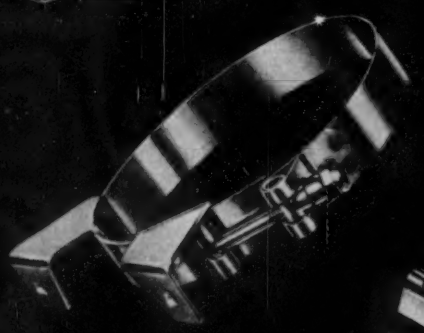

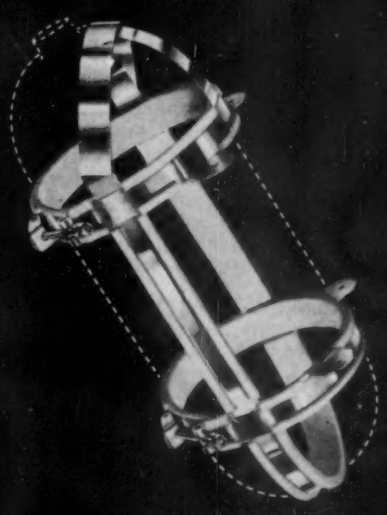

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Washington Roundup

No Subsidy Payments?

Civil Aeronautics Board is likely to run out of funds for subsidy payments shortly. The Board set its requirement for payments between now and the end of the fiscal year, June 30, at $15.2 million. Congress voted only $8.9 million.

It's a question as to which carriers will be forced to go without their allocations:

• According to CAB Member Chan Gurney, the Board is obliged under the 1938 Civil Aeronautics Act to make payments to all carriers as claims fall due—until CAB runs out of funds.

• House-Senate conferees, in a report, directed that the entire $8.9 million be used for payments to local service airlines. This provision—which would mean that the entire $6.3 million cut in subsidy money would be applied to other domestic and international carriers—is not written into legislation.

These questions are raised:

How much weight will CAB give a congressional recommendation?

Are carriers entitled to payments, determined by CAB under the authority of the 1938 CAA Act, and warranted in suing to collect?

Meanwhile, industry circles hope CAB will make another effort to obtain funds from Congress.

Opinions by Newbury

Undaunted by hostile industry and military reaction to his proposal that turbine engine developments be restricted to units of standard size and thrust, Defense Department's assistant secretary for Applications Engineering Frank D. Newbury now appears to be scanning the entire aircraft industry with a skeptical eye on its ability. Newbury said last week:

"The most serious limitation of progress in our overall defensive position, especially in the development field, is the scarcity of qualified research and engineering and production organizations."

Objectives of the Office of Applications Engineering, Newbury said, are:

• A policy of concentration of effort on a smaller number of major developments to conserve our limited national resources of qualified engineering manpower and industry.

• A policy of consolidating engineering experience in the military departments along with consolidation of development facilities.

• A policy of extending the assignment to a single service of responsibility for the development and procurement of a specific type of equipment that will be used by more than one service.

• A policy of awarding initial production contracts to the contractor who developed a new device and not necessarily to the lowest bidder.

Newbury maintains that Russia's fast technological progress is due to its ability to force development.

"If we ever lose the armament race to the USSR," he said, "with its more limited technical and industrial resources, it will be because the USSR has of necessity practiced a policy of selection of its objectives and concentration of its resources, concentration on heavy industry as against consumer goods, and concentration on a relatively few types and sizes of weapons and equipment in its military program."

The assistant secretary revealed that a comprehensive study of aircraft armament also is under way, with the goal of eliminating some of the 30 different types and sizes of aircraft armament used by Navy and Air Force.

Honaman to Pentagon

R. Karl Honaman now appears certain to take over job as head of the Pentagon's security program May 1. Present chief of Commerce Department's Office of Strategic Information, a job for which he was chosen by the White House, he is working in Defense Department offices and is expected to be sworn in soon as replacement for D. Walter Swan, who has returned to United Air Lines from his post as Deputy for Public Affairs to Assistant Secretary Robert T. Ross (AW Apr. 18, p. 13).

Dealing with Honaman, contractors and the press will face a veteran engineer with broad experience in the field of technical publications. On loan from Bell Telephone Laboratories, where he is Director of Publications, Honaman worked on airplane engine designs in Washington during World War I. He joined AT&T's research activities in 1919 and has been with the company ever since. His activity at OSI, where he went last November, appears to have been mostly in the field of studying the problem of information that leaks to the potential enemy, combined with diplomatic efforts to curtail the flow in some fields. In his new job, he will have direct power to approve or disapprove release of information. Major headache will be interpretation of Defense Secretary Charles E. Wilson's order that material given out must be "constructive" in its contribution to the department.

Permanent Feeders

The White House is expected to go along with legislation directing Civil Aeronautics Board to give permanent certificates to the 14 local service airlines. It passed both House and Senate by voice vote.

The Republican support for the measure in the Congress, as well as the Democratic, is overwhelming. Rep. Carl Hinshaw, high-ranking Republican on the House Commerce Committee, predicts that both houses would overwhelmingly over-ride a presidential veto.

Although Commerce Department and Civil Aeronautics Board have taken an official position in opposition to the legislation, Under Secretary of Commerce for Transportation Louis Rothschild, Assistant Secretary of Commerce Walter Williams and CAB's new chairman, Ross Rizley, are not expected to put up strong cases for a veto. This leaves Commerce Secretary Sinclair Weeks to carry the ball for a veto, and if he does, his position is not expected to prevail.

Contract Publicity

Defense Department is trying to work out a program of advertising contracts to be negotiated. The recommendation was made by Sen. James Duff of the Senate Committee on Small Business and given enthusiastic support by Assistant Secretary of Defense Thomas Pike.

Duff concurred with Pike that procurement items for aircraft and guided missiles do not lend themselves to competitive bid contracting. "But there is a public suspicion that negotiated contracts are being passed out under the table to favorites," Duff commented, "and that public opposition has got to be eliminated." Pike said the advertising program would be "sound."

—Washington staff

AVIATION WEEK VOL. 62, NO. 17
APRIL 25, 1955

New Cost Plan Threatens Incentive Pay

Proposed new ASPR Section XV would liberalize government treatment of research project expenses.

By Claude Witze

Showdown between U. S. Air Force and major aircraft manufacturers over the question of cost-allowability of profit-sharing and stock bonus plans appeared likely last week as industry studied proposed revisions to Section XV of the Armed Services Procurement Regulations.

Immediate reaction of industry to the proposed changes was that all incentive pay plans are threatened in the plants of companies that do most or all of their business with the Defense Department.

USAF, sternest of the armed forces in its disapproval of profit-sharing expense as part of the costs to be reimbursed on cost-plus-fixed-fee contracts, indicated that no final decision has been reached. It is expected that uniform treatment of the question will result from agreement of USAF, Army and Navy procurement officials on how the new regulations will be applied.

Crux of the issue appears to be a proposed regulation that says cost of profit-sharing plans will not be allowable if "the business of the contractor at the time of entering into the contract is less than 75% with non-governmental customers, taking into account the amount of the contract in question." Only exception would be through special contract provision.

Restrictions

Situation in which profit sharing would be an allowable cost is restricted, along with bonuses, by these conditions:

- They must be paid under an agreement made before the work is performed and follow an established plan that is an obligation by the contractor.
- They must be reasonable.
- They must be paid for current services actually rendered.
- They must be available to all employes or at least all within a non-restricting classification.
- They must be allowable for tax purposes.
- They must not be restricted to stockholders.
- They must not exceed 15% of the total basic pay accrued to an employe.

Additional restrictions are imposed in the proposed regulations concerning the allowability of costs of stock bonus plans. These involve value placed on the stock, previously unissued stock and credit adjustments for employes who do not acquire the intended shares.

Industry reaction to these restrictions generally is that they fail to make proper distinction between "splitting a melon" and true incentive compensation. Fearing that the new rule will result in disallowance of all incentives, particularly in firms doing a large share of defense work, they point out that bonus plans are a standard business tool for stabilization of personnel at all levels.

Defense Department attitude, on the other hand, is that the government must be protected against unreasonable programs that will add materially to payments under cost-plus-fixed-fee contracts.

Expands, Clarifies

The proposed revisions of Section XV have been circulated to ten industrial associations, including Aircraft Industries Assn. and the Radio-Electronics-Television Manufacturers Assn., for comment. Defense Department has set May 23 as deadline for receipt of their opinions.

New Section XV represents a big expansion of the old rules with emphasis on clarification and the provision of details to guide armed services procurement officers. Each item of cost that is covered is defined, with a statement as to extent of allowability, unallowability and whether provision must be made in the contract to permit allowability.

Aside from the clauses on profit-sharing and bonus payments, major interest of the aviation and avionics industries may be in the new rules on allowability of expenses for research and development. In a complete reversal of policy that could result in stimulation of R & D projects conducted by industry without specific contracts to cover them, the costs are made allowable within the framework of broad restrictions.

General research—defined with enough liberality to include "blue sky" projects—is recognized as a basic industrial activity that must be fostered. In past Air Force contracts, costs for this work were allowable only when stipulation was included in agreement.

Liberalize R & D

Under the proposed new ASPR, costs of a contractor's independent general research are allowable under these conditions:

ASPR Principles and Standards

Here are the basic principles and standards used by the Defense Department in drafting proposed new Armed Services Procurement Regulations:

- **Composition of total cost. The total cost of a cost-reimbursement type contract is the net sum of (1) the allowable direct costs; (2) the properly allocable portion of allowable indirect costs; (3) applicable income and other credits.**
- **Factors affecting allowability of costs. The factors to be considered in determining the allowability of costs include (1) reasonableness; (2) application of generally accepted accounting principles and practices; (3) exercise of good business judgment in incurrence of cost; (4) significant deviations in the established practices of the contractor which substantially increase the contract costs; (5) any limitations as to types or amounts of cost items set forth in this part 2 of section XV or otherwise included in the contract.**
- **Credits. The applicable portion of income and other credits, rebates, allowances, and equivalent benefits accruing to the contractor and which are related to any allowed cost will be credited to the government either as a reduction in contract cost or by a cash refund, as appropriate.**
- **Contractor's accounting system. The requirements concerning record keeping and approval of the contractor's accounting procedures and practices are set forth in the "records clause." (See ASPR 7-203.7)**

• The amount is reasonable.
• Costs are equitably allocated to all work of the contractor rather than its independent general and related research.
• The contractor agrees to divulge to the government the results of such general research.
• The business of the contractor at the time of entering the contract is predominantly (75% or more) with non-governmental customers. If less than 75% at the time of entering into the contract, allowance may then be authorized by a special provision in the contract.

Related research is defined as work that is directed at the production of something useful. In this case, costs will be allowed if allocated on the basis of all production.

Other highlights from the proposed procurement regulation revision include the following:

• **Selling and distribution expenses** generally are not allowable. However, there may be an allocation for the work of service departments, providing technical, consulting and other "beneficial services."

• **Advertising expense** rules are unchanged. Expense is allowable only in trade and technical journals valuable for dissemination of information in the industry, and for help wanted advertising.

• **Bidding expenses** "will be treated as indirect expenses" and allocated currently to all business of the contract contractor.

• **Cafeterias and dining rooms,** formerly allowed only on the basis of individual contracts, now have their costs allowed when losses are realized within certain restrictions.

• **Civil defense expenses** are allowable within reasonable limitations.

• **Contributions and donations** are allowable. This marks a reversal in policy and is a change that was opposed by the government's General Accounting Office.

• **Depreciation section** of the ASPR has been greatly expanded in an effort to keep defense plants more up-to-date. New accounting methods of the Internal Revenue Code have been adopted, reversing an opposite stand taken in the past by USAF. Costs are allowable and faster depreciation is permitted in the early years of writing off the cost of facility.

• **Initial production costs** are allowable, but the contractor is expected to make an effort to reduce them as much as possible.

• **Insurance indemnification** is allowable when the coverage is demanded by the government. Other insurance is allowable if approved by the customer or the coverage and cost is reasonable under the circumstances. The section adds: "Costs allowed for use and occupancy insurance, however, will in principle be limited so as to exclude coverage of profit, interest, federal income taxes, and any other items of expense unallowable under this part."

LUFTHANSA'S SUPER CONSTELLATION, first of eight ordered from Lockheed Aircraft Corp., makes its delivery flight from Burbank, Calif., to Hamburg, Germany. Bi-weekly Hamburg-New York service starts in June, with six flights per week scheduled in July.

• **Interest and other financial expenses** are not allowable except for interest assessed by state or local taxing authorities.

• **Materials and supplies** allowability clauses are vastly expanded, giving more detail to cover varied circumstances. One section of the regulation stipulates that when an item is bought by the contractor from another division or plant of the same firm the price must not exceed that given the most favored customer or available from another supplier.

• **Pension and retirement** plans clauses have been rewritten with new material. General purpose is to recognize that companies with pension plans based on actuarial figures have a set obligation, with proper protection for the government in allowing reimbursement of costs.

• **Reconversion expenses,** incurred when the plant must be restored to the condition existing before work was started on a military contract, are not allowable except when this provision is specifically provided for in the original contract.

• **Rentals of plant and equipment** are allowable with limitations. These include a guard against transfer of title and lease-back at a cost that would exceed the normal rental cost of the facility.

• **Severance pay** is allowable only to the extent that it is required by law, union agreements, established company policy or particular circumstances. In the case of a mass dismissal made at close of the contract, the cost is allowable but must be equitably apportioned to such cost of all business of the contractor during the period of employment.

• **Taxes are allowable,** with the exception of federal income and excess profits, those incurred by financing operations, those from which exemption is available and special assessments on land which represent capital improvements.

• **Trade, business and professional** activity expenses are made allowable but confined to activity helping in the dissemination of technical information. This protects the government against being charged for the cost of running lobby activities.

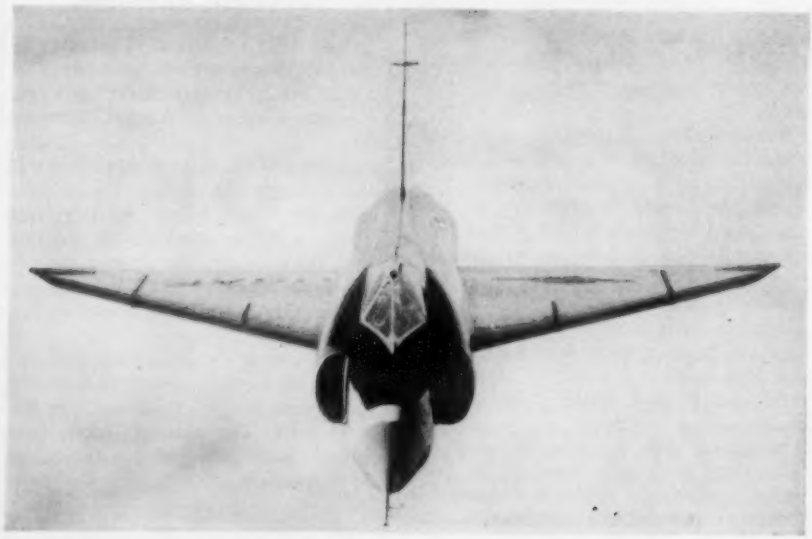
Aircraft Earnings

Total 1954 earnings of 12 major U. S. airframe manufacturers amounted to $182.6 million on sales of $4,926.8 million, according to the Aircraft Industries Assn.

Backlog of the firms at year's end was approximately $10.4 billion. This is lower than the $11.6 billion figure a year earlier, a change attributed to the fact that the industry "has crossed the so-called production plateau."

The 1954 earnings rate was 3.7% on sales.

The industry's working capital was increased during the year to $442.1 million, an increase of $92.3 million over the 1953 total. The airframe makers paid federal taxes in 1954 amounting to $188.4 million.



Convair F-102A's Supersonic Shape

Knife-edged and wasp-waisted, Convair's F-102A slashes through the Southern California sky showing off the form that made it supersonic in level flight. Changes in fuselage layout and canopy shape, plus more power from its P&WA J57, dropped the drag and boosted the speed over the Mach 1 mark. Wing leading edges were drooped to improve the lowspeed range of flight. Tail blisters help reduce flow breakaway at the fighter's critical wing-tail-fuselage junction.

SAE Holds 1955 Aeronautic Meeting

There is a prime reason for having an engineering society meeting: to discuss new problems with old friends.

Last week in New York, during its Golden Anniversary year, the Society of Automotive Engineers staged its aeronautic meeting, engineering display and production forum.

This staff report of the SAE Aeronautic Meeting was prepared by Aviation Week editors A. W. Jessup, David A. Anderton, G. L. Christian, Henry Lefer and Gordon C. Conley.

More than 1,200 engineers–highest attendance in SAE's 50-yr. history–pondered the problems of powerplants, talked transport for short and long hauls and ranged into the exotic fringe of boundary layer control, human factors and noise.

Propulsion progress dominated the first three days' sessions, with air transport a close second.

We know where we are going in powerplant development, but we're not sure how best to get there.

The reason: There are about 500,000 possible ways of optimizing future engine performance, W. G. Lundquist, vice president of Wright Aeronautical Division, told the SAE.

But several stand out as immediate choices: Increasing airflow per unit cross-section area, increasing operating temperatures and lowering specific weights and fuel consumptions.

This means transonic and supersonic compressors, larger single engines rather than multiple powerplants, high-temperature materials, turbine-blade cooling, lighter materials and possibly higher compression ratios.

A cold fire-up vibration was one of the unique aspects of the Allison T56 turboprop, said engineers J. B. Wheatley, D. G. Zimmerman and R. W. Hicks. On starting a cold engine, there would be lots of vibration at the turbine shaft frequency. If the engine were shut down and restarted immediately, vibration would reduce to an acceptable level. The trouble was traced to a turbine front bearing support structure that was sensitive to temperature changes.

Bristol's B.E. 25 superchargd turboprop will produce more power in the Britannia than the airframe can use because of Mach number limitations, said Dr. Stanley Hooker, chief engineer of Bristol's engine division. In order to exploit the new engine fully, he said, a new airframe must be made available.

Bristol's development powerplant is designed to give 3,500 cruise horsepower at 30,000 ft.; its takeoff power can be kept constant at 4,000 at any airport in the world.

Fairchild experience with the lightweight, high-thrust J44 turbojet has shown the versatility of such engines, according to A. T. Gregory, chief engineer for research and advanced engineering of Fairchild's Engine Division.

Originally conceived for expendable use on drones and missiles, the developed engines have also been used on Bell's VTOL testbed and as jet-assist takeoff units on the Fairchild-built C-82 and C-123. A future possibility: Auxiliary power units for boundary layer control.

► **Missile Motors**–Expendable turbojets are good for missile applications because they can be obtained quickly and at lower cost, said J. D. Rogers, of Westinghouse's Aviation Gas Turbine Division.

No, they aren't, said a Navy BuOrd engineer. Experience has shown the development time and cost is about the same as for a non-expendable engine. It's too easy to exceed the unrealistic 10-hr. life in service, he added.

As soon as there is a good expendable engine development, said a General Electric engineer, it shows potential for non-expendable uses and there goes the short-life concept.

French and British Techniques

Production quantity is the real key to the basic design and qualification differences between U. S. and foreign engines, Whitney Collins, chief engineer of Continental Aviation & Engineering Corp.'s Gas Turbine division, told a panel session. By our standards, French production lines–typified by Turbomeca, whose engines Continental is now building in the U.S.–are only comparable to a prototype or a pilot line.

The French are experts in prototype development, Collins stated. Their system for development has four specific advantages:

- **Incentive development contracts** where better performance is tied to a bonus.
- **Flexibility of design specs.** Only a single design report is prepared for a single responsible official from the monitoring agency.
- **No need for aerodynamic component** development before first series of engines is built, made up for in part by tests performed on similar or scaled components.
- **Dominance of the engine manufacturer** over the airframe and military representatives for the formative design stages.

► **British Better?**–Big advantage of the British engine industry is the extreme competence of their experimental shop personnel, who are able to design parts, make necessary tools and produce pilot quantities, said Arnold Redding.

Other advantages cited by the Westinghouse preliminary design chief:

- **Emphasis on getting a prototype** engine in shape to evaluate its full potential.
- **Better supplier relations** because the firms are smaller and have to be cooperative.
- **Slower airframe development,** allowing time for tailoring the engine to the plane.

Test differences between British and U. S. engines were discussed at length by H. W. Paige, manager of J47 and J73 engine projects for the General Electric Co.'s Aircraft Gas Turbine Division.

Significant differences: British clear an engine for first flight after 25 hr. ground running, not necessarily at full

REPUBLIC XF-84H instrumented for vibration tests. This is first picture of new craft.

specification rating; we ask for 50 hr. and full rating.

Thrust rating on acceptance tests is averaged over the first 20 engines in Britain, and acceptable figures can go as low as 4% below the type rating. Here, each engine must qualify at full rating.

General conclusion was that British engine developers had a better time of it, with more financial backing of development work, more highly skilled machinists and mechanics, and less-rigorous, more-realistic test and qualification requirements.

More than one U. S. engineer suggested that one or another portion of the British program be adopted here.

Military Transports Expanding

Air transport for the miltary services is headed for rapid expansion, ranging from frontline tactical movement of troops and supplies to short-haul combat zone and zone of interior communications to intercontinental logistics.

As outlined at the military transport session of the SAE, this growth creates many new requirements in helicopters, fixed-wing cargo aircraft and powerplants.

Helicopters

Helicopters have become a primary assault vehicle for the Marine Corps, according to Col. K. B. McCutcheon, of the Corps' equipment board. After listing a multitude of battle uses, he pointed out that "it is in amphibious operations that the Marine Corps is primarily interested in applying these (helicopter) techniques."

Assault landing forces of the traditional type would form an ideal target for an enemy equipped with nuclear weapons. Korean experience, however, showed that the helicopter provides a new dimension of transportation, enabling the Marines to conduct a landing operation from a mobile, continually moving and dispersed task force without providing concentrated targets for atomic weapons (AW July 14, 1952, p. 16). From troop-carrying, converted aircraft carriers, helicopters could rapidly mass an attack force on selected enemy objectives.

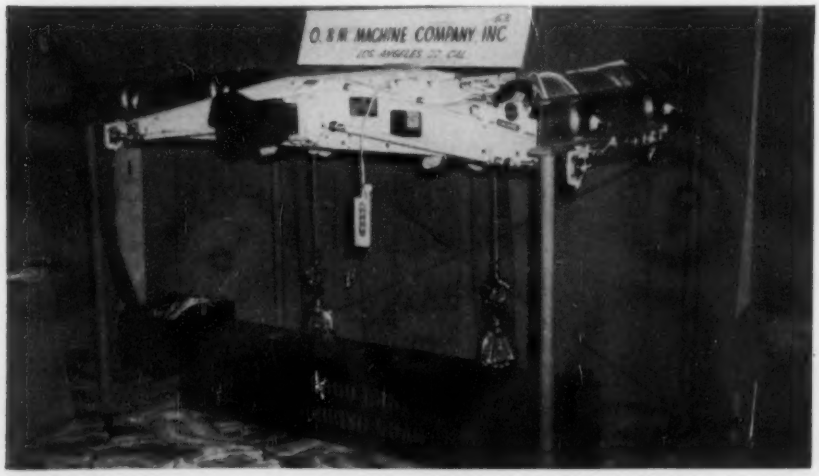
Three new types of transports were listed by W. R. Rhoads, division engineer, Lockheed Aircraft Corp., as needed to replace today's obsolete military cargo aircraft:

- **A short-haul cargo plane,** capable of vertical takeoff and landing, with a 600-nautical-mi. radius and 10-ton payload for operations within the ZI industrial complex as well as in the combat zone.
- **A medium-haul aircraft,** capable of operating on short or rough airstrips, carrying 25-ton payloads 1,500 to 3,000 mi. within the ZI, to overseas bases, and from overseas bases to combat zones.
- **Long-haul transports** lifting 50 to 100 tons for 4,000 miles or more in intercontinental operations.

He recommended more detailed studies of potential air cargo, route networks, cargo handling, terminal design and global communications.

Turboprop Aircraft

Aircraft to meet Rhoads' specifications are in part on the way, according to a paper delivered by Capt. Richard D. Cousins. Besides the Lockheed C-130 Hercules, which uses approximately "two-thirds less runway for takeoff than any current piston-engine transport having equivalent gross weight," Capt. Cousins listed these aircraft in Phase Four of USAF's turboprop development:



CARGO HOIST for Douglas C-124 series manufactured by O & M Machine Co., Inc.

FORGED FRAME by Wyman-Gordon.

- **Douglas XC-132,** powered by P&WA XT57 engines, with a heavy maximum design gross weight for transporting supplies directly to overseas theaters.
- **Douglas XC-133A,** powered by P&WA's T34-P3, with a maximum design gross of 255,000 lb. for long-range transportation of cargo only.

Phase Three testing consists of running turboprop engines in commercial airframes: Convair's YC-131C, Boeing's YC-97J, Lockheed's YC-121F, and Douglas's YC-124B. Preliminary performance of the YC-131C, revealed improved takeoff (25%), climb (50%), cruise (15 to 30%) and payload over piston-engined versions.

Phase One test of Convair's XP-81 was abandoned after 30 hours of flight because of inability to control propeller and turbine speeds.

Phase Two, which is continuing with turbine engines mounted in the Republic XF-84H and the Boeing XB-47D, also included the McDonnell XF-88. The XB-47D test is to determine the feasibility of high-speed, long-range composite bombers utilizing both turbojet and turboprop engines.

Airline Helicopter

Total operating costs of helicopters on short-haul routes will be lower than those of fixed-wing transports by 1965.

With economical operation plus mid-city heliports, copters will begin to slice into the near monopoly of surface transports on routes up to 250 miles and, within the next 10 years, take the bulk of traffic away from railroads and motor buses.

These forecasts were made by Grahame H. Aldrich, director of special projects for Air Transport Assn.'s Division of Air Transport Economics, at

the helicopter forum of the Society.

In the forum on short-haul transports, however, Mohawk Airlines President Robert E. Peach said the public must be sold on the copter before it can be used to penetrate the short-haul market. Mohawk was forced to suspend its experimental Sikorsky S-55 flights because communities failed to realize the potential of helicopter services.

"We found that small communities were absolutely aghast at the idea of landing a flying machine eight or 10 times a day in the heart of the community," Peach reported. "In the major cities, we found that land values and land uses have already effectively cancelled almost any possibility of mid-town heliport operation on a scheduled basis."

Cost Reduction

Aldrich said total operation costs for a multi-engine helicopter in 1965 should average not more than $0.080 per available seat-mile at stage lengths of less than 200 miles ($0.036 direct and $0.044 indirect). This compares with an average of $0.1184 for present twin-engine fixed-wing transports ($0.0206 direct and $0.0978 indirect).

The copter's economic edge over present short-haul aircraft lies in its lower level of indirect operating costs including passenger services, the ATA official said.

"The fixed-wing reservation system . . . is an excellent device for long-haul and intermediate traffic but one of real inconvenience to a passenger who frequently travels but 25 minutes per day," he said.

"As a replacement, it seems both practical and possible to adjust schedule frequency to the flow of traffic. The high numerical volume of intercity passengers who travel less than 200 miles do so in a relatively stable pattern of distance, time of arrival and time of departure."

First twin-engine copter transports, probably the Sikorsky S-56 and Piasecki YH-16, will have an estimated direct operating cost of between $0.056 and $0.070 per available seat-mile at stage-lengths ranging from 50 to 100 miles. This compares with the modern fixed-wing average of $0.032 at 50 miles and $0.0238 at 125 miles.

He predicted a "calculated average trend" of reductions that would cut direct operating costs of copter transports to $0.0496 in 1960 and $0.0361 in 1965.

Aldrich said helicopter fares on short-haul routes should follow a similar trend, ranging between 8 and 10 cents per mile at first and dropping to 6 or 7 cents when airlines begin operating copters in fleet strength.

Vital factor in Aldrich's optimistic forecast is the construction of major heliports, located in sites that would be as convenient as present railroad depots and bus terminals.

The Air Transport Assn. official gave this anticipated status of heliport availability: 1958, construction under way at major traffic centers; 1960, construction started at secondary points; 1965, adequate.

Accessory Problem

The most perplexing problem facing powerplant engineers when laying down a new turbojet engine is establishing provisions for auxiliary power takeoffs, a Navy Bureau of Aeronautics representative told the Accessory Power Source session.

Accessory mounting directly on the engine, is the configuration preferred by most airframe manufacturers because it is lightest and simplest.

But powerplant engineers recommended remotely located, mechanically-driven accessories because installation flexibility permits many accessory combinations without changing engine configuration.

Higher speeds dictate smaller engine frontal areas, marking a trend towards driving accessories from a simple power takeoff because there will not be room for anything more elaborate.

The USAF favored remote accessories driven pneumatically by compressor bleed air because engine change is simplified, engine build-up is rapid, and one engine configuration could fit many planes, easing logistics requirements—especially when ever Air Force bases are air-supplied. Accessories can be checked out on the ground by auxiliary power supplies without having to run up the engine.

Multiple systems, both electrical and hydraulic, were suggested for future aircraft. Certain new avionic equipment, with modest current demands in the 2-4 Kva. power range, require a.c. current with frequency held to very narrow tolerances. So why not provide separate power supply to feed these frequency-conscious circuits, suggested an engineer? This would allow the main a.c. supply, which may be required to generate current in the 240 Kva. power range, to be coarsely controlled.

Hydraulically, the trend is to split utility systems—landing gear operation, flaps, speed brakes—from the dual power control system used to fly the aircraft. This will require a third hydraulic pump pad on the accessory drive.

Another electrical trend is towards an alternating current airplane with no d.c. generators at all. Small direct current requirements will be furnished by a rectifier that will convert d.c. from a.c.

Bleed air is becoming too hot to handle. This is further complicated by the fact that modern turbojets used synthetic oils which may leak past engine seals and contaminate bleed air. Replacement would be a mechanically-driven pneumatic pump and still another drive pad.

SAE Observer

McDonnell's XF-88 testbed for Allison's T38 turboprop has reached Mach 1 in full-power, shallow dives.

Republic's XF-84H turboprop test vehicle is undergoing ground and prop vibration tests at Edwards AFB. Powerplant is Allison's T40. Now a supersonic propeller research vehicle, development could lead to an all-purpose fighter and fighter-bomber.

Ducted-fan engine with design rating of about 12,000 lb. was the aim of Packard Motor Car's jet engine division as far back as 1946. Program was cancelled in 1948.

Thrust-weight ratios of 10:1 are believed attainable in future turbojet engines for manned aircraft.

North American F-86F modified with porous leading edges was first jet fighter to fly with boundary layer control in this country. Maiden flight was Sept. 18, 1953.

Chase XC-123D with ejector boundary-layer control system flew Dec. 7, 1954 at Stroukoff Aircraft Co., now is in flight evaluation at Wright Air Development Center.

New French system of boundary-layer control is step closer to complete integration of airframe and engine. All engine exhaust is blown out of wing trailing edge for propulsion and boundary-layer control.

Drag chute does twice as much good as brakes on aborted takeoff 10 kts. under unstick speed. Boeing B-47 chute drag force is 38,000 lb. at 160 kts.

Pike Orders 'Fair' Subcontract Share Must Go to Small Firms

Defense Department last week issued instructions to its procurement officials that they must assure a larger share of sub-contracts for concerns employing fewer than 500 persons. The action came on the day that hearings opened before the Senate Committee on Small Business.

The new instruction, carrying out a policy ordered into effect by Defense Secretary Charles E. Wilson five months ago, was issued by Thomas P. Pike, Assistant Secretary for Supply and Logistics.

Policy is laid down aiming for a "fair proportion of the total purchases and contracts for supplies and services" to small business. This must include, the policy says, measures designed to give these firms a fair share of sub-contracts.

Program for Contractors

To carry out these policies:

- In contracts exceeding $5,000 there will be a clause requiring that small business get the maximum amount of subcontracting consistent with efficient performance.
- Each firm getting a prime contract in excess of $1 million will be "urged" to set up a defense subcontracting small business program.

In this case, a prime contractor's program will include these measures:

- Appointment of a small business liaison officer to make sure the subcontracting clause of the contract is carried out.
- Publication of the program with the company.
- Use of company procurement policies to give equitable opportunity to small business firms.
- Maintenance of records to show which sources are in the small business category.
- Placing of the subcontract clause in all subcontracts.
- Urging of subcontractors to run their own small business programs.
- Full utilization of Defense Department and Small Business Administration data on small business sources.
- Provision of subcontracting information to the customer on demand.

Pike told the Senate committee his office has been working on the problem for nearly a year and "for the last week it has been touch and go as to whether we would have this instruction in final form before these hearings."

He also said "many large prime contractors already have such programs. Many others will adopt them in the future or revive existing programs."

Pike's office also has eliminated the term "suitable for small business" as a classification for items purchased by the military services. In a proposed revision of the procurement action report all awards are allocated to one of four classifications:

- **Awarded to small business.**
- **No known small business suppliers.**
- **Awarded to sole source** large business suppliers.
- **Offered to small business** but awarded to large business for specified reasons.

USAF Seeks Funds For A-Engine Lab

Department of Defense last week sent to Congress a bill seeking authorization for a $2,234 million public works program with nearly half the total—$1,173 million—for the Air Force.

Included is authorization for the construction of research and development facilities at Hartford, Conn., involving expenditure of $22.3 million. Listed under projects of the Air Research and Development Command, the job presumably is for the Pratt & Whitney Aircraft Atomic Engine Laboratory, construction of which is expected to begin late this year (AW Dec. 20, 1954, p. 11).

Second major item in USAF requests is for construction of aircraft control and warning systems at home and abroad at a total cost of $198.9 million. Including work on the Distant Early Warning (DEW) line as well as other communication and navigations aids, necessary operating, training and housing facilities, expenditures of $100.4 million are proposed in the United States and $98.5 million at sites abroad.

Total of new Air Force projects in the bill is made up of $703.3 million in continental U.S., $465.4 million overseas and $5 million of classified construction jobs.

Major USAF projects, in excess of $10 million, include:

- **Air Defense Command.** $11.5 million at Buckingham Weapons Center, Ft. Myers, Fla., $16.5 million for facilities in the greater Milwaukee area, Wisc.
- **Air Materiel Command.** $15.6 million at Griffiss AFB, Rome, N. Y.; $21.3 million at Olmsted AFB, Middletown, Pa.; $17.9 million at Wright-Patterson AFB, Dayton, Ohio.
- **Air Research and Development Command.** In addition to the Hartford project: $12.4 million at Edwards AFB, Muroc, Cal., and $20 million for research and development facilities at various locations.
- **Strategic Air Command.** $10.2 million at Clinton-Sherman AFB, Clinton, Okla.; $11.1 million at Dow AFB, Bangor, Me.; $11.1 million at Ellsworth AFB, Rapid City, S. D.; $22 million at Plattsburg AFB, Plattsburg, N. Y.; $24.8 million at Portsmouth AFB, Portsmouth, N. H.

Security Cloaks F-104 Crash

Los Angeles—USAF and Lockheed Aircraft Corp. clamped a tight security curtain last week around the crash of the supersonic F-104 fighter.

Company test pilot Herman (Fish) Salmon ejected from the spear-nosed experimental jet and was picked up in the desert by helicopter several hours later. Except for bruises, he was unharmed.

Lockheed and Air Force officials would not comment on what caused the crash. Reliable sources said the emergency was not due to failure of either the stub-winged aircraft or its Wright J65 Sapphire turbojet. It is known, however, that Salmon was making a dead-stick descent with the aircraft under control when he ejected at 18,000 ft. Speed at the time of ejection was 250 mph.

Estimates of top speed of the F-104 have ranged from 1,000 mph. to 1,500 mph. The aircraft was making level, very high altitude runs at the time of the emergency, according to one source.

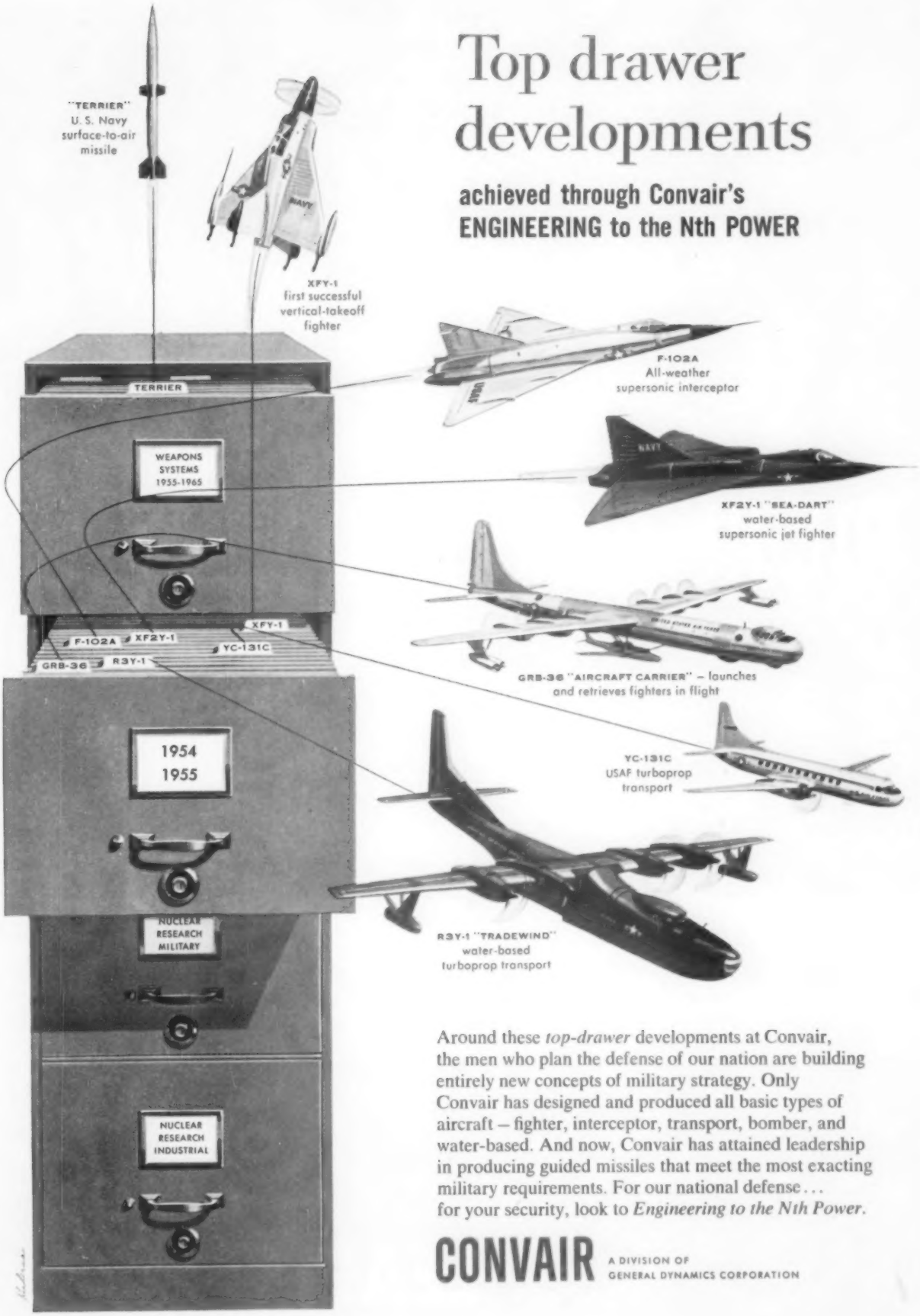
Salmon was over a rocky area of the Mojave Desert when he bailed out and may have decided to eject rather than attempt a forced landing in a section cut through with deep ravines. First reports said he radioed the Lockheed base at Palmdale that he would attempt to return the plane for an emergency landing.

It was not revealed whether the crash was related in any way to the recent F-104 emergency which caused test pilot Tony Levier to make a forced landing on the dry lake bed at Edwards AFB (AW Apr. 4, p. 9). At that time, an ejected cartridge link punched a hole in a fuel tank during gun-firing runs. When leaking fuel was sucked into the engine through the air intake, it caused the Sapphire to run extremely rough and Levier set the aircraft down on the lake bed without further damage.

Second of the twoo F-104 prototypes still is on flight status at the Palmdale test facility. First flight of the new fighter was in February 1954.

Top drawer developments

achieved through Convair's ENGINEERING to the Nth POWER



Around these *top-drawer* developments at Convair, the men who plan the defense of our nation are building entirely new concepts of military strategy. Only Convair has designed and produced all basic types of aircraft – fighter, interceptor, transport, bomber, and water-based. And now, Convair has attained leadership in producing guided missiles that meet the most exacting military requirements. For our national defense... for your security, look to *Engineering to the Nth Power.*

CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION

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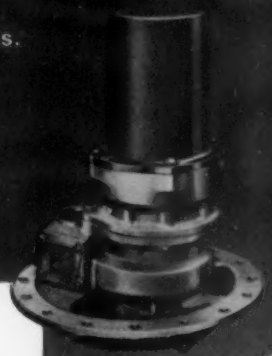
Altitude is power in aerial warfare. Leading U.S. jets fly higher, nourished by Lear-Romec fuel booster pumps. These service-tested pumps deliver tons-per-hour of vapor-free fuel, even at stratospheric altitudes where fuel boils in the tanks. That's quite a trick.



These first-line, high-altitude jets use Lear-Romec fuel booster pumps (available for both AC and DC operation).

LEAR LEAR-ROMEC DIVISION Elyria, Ohio

RO-14

Air Transportation Will Advance Spectacularly, Says Fund Forecast

A continued high level of consumer spending for personal transportation is forecast in an economic study by the Twentieth Century Fund with expenditures for airline travel in 1960 increasing 188% over 1950.

Domestic air traffic for all carriers in 1960 is estimated at 25 billion passenger-miles.

These three developments are viewed as the probable outstanding factors in the airline transportation picture for 1960:

- Airline travel growth as flight safety and dependability, technological advances and new navigational aids contribute to a tripling of air traffic volume between 1950 and 1960.
- Municipal awakening to the need for extensive capital investment in facilities for transportation.
- Continued growth of private transportation through expansion of automobile ownership and acceleration of highway improvement.

These estimates are made on the assumption that the economy will be free of a major war or a depression, that population will grow 16% and real national income will increase at least 30%.

▶ **Aviation Takes Lead**—The Twentieth Century Fund report, "America's Needs and Resources: A New Survey," brings up to date a survey made of the American economy that was originally started in 1942 and first published in its present from in 1947.

"The most spectacular developments in transportation have occurred in aviation," the report says, "and it is aviation which promises to exert the greatest influence on the transportation system during the years immediately ahead—partly because of the helicopter and partly because of the opportunities for further increasing airplane speed.

"The progress already made has been tremendous, but the possibilities now in sight through jet propulsion, rocket power and the application of atomic energy overshadow past achievements," the report states.

▶ **Copter Advantages**—The helicopter is seen in the report as a key aviation development.

Its great future importance lies in its ability to cut loss of time in surface travel to and from airports. Example of the advantage of rotary wing over regular service:

On a trip of around 200 mi. a helicopter that is capable of 100 mph. offers faster service between downtown areas than an airplane traveling 170 mph. Counting ground time at each terminal of 5 min. for the helicopter and 30 min. for the airplane, the helicopter averages 89.6 mph. and the airplane 86.3 mph.

Technological improvements in the helicopter are expected to extend its advantages for short trips over the airplane.

▶ **Convertiplane Potential**—The report points out the rotary wing aircraft has a very advantageous flexibility. In the future, it will be capable of use between downtown and airport, between airport and airport, for metropolitan transportation and for intercity trips under 300 mi.

If helicopter principles can be successfully applied to the airplane, the report predicts that in the convertiplane "may lie the greatest potential for all-weather navigation, speed and safety in the air."

Principal deterrents to an accelerated shift from rail to air travel, according to the report, are "cost and safety factors, lack of capacity to handle air traffic expeditiously at the airports, inability to meet the problem of ground travel to and from the airports, and the ability of the railroads in many cases to provide modern equipment for luxury travel."

▶ **Air Traffic to Gain**—Development of helicopter and jet transport services by 1960 is expected to improve the competitive position of airlines with regard to the railroads.

Rail passenger traffic, hit in recent years by competition from air and highway travel, is expected to decline from 27 billion passenger-miles in 1953 to 22 billion in 1960.

Total intercity traffic in 1960 is expected to reach 66 billion passenger-miles—25 billion by air, 22 billion by rail and 19 billion by bus. This total compares with 56 billion in 1950 and 61 billion in 1953. Consumers will account for approximately 70% of this traffic.

Rising trends in foreign travel are expected to continue. Travel to and from overseas countries is expected to go from 2.9 million passengers in 1953 to 4 million in 1960, with two-thirds of these ocean-crossing passengers going by air.

Airport needs, including heliports, are estimated at $100 million a year. The report says that introduction of jet transports may hasten obsolescence of terminals and that expansion of passenger and freight traffic will increase the need for buildings and other facilities.

Avionic Test-Bed Gets T41 Turbines

Two Solar T41 gas turbines, drawn under the wing of a Convair C-131B, would supply electrical power to the avionic test-bed Convair claims it will be the first externally mounted gas turbine source of extra electric power. Housed in plastic or metal pods, the portable units are designed for quick installation. The two-pod combination drives an a.c. generator capable of supplying up to 30 kva. of 115/208-volt three-phase power plus a d.c. unit that will provide a total of 17.5 kw. at 28 volts at sea level. Alternative arrangements provide for a 60-kva. total generating capacity on a split bus system or a common bus that will produce up to 35 kw.

Avco Forms Air Weapons Team

One-Half the Size

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Advanced **DESIGN**
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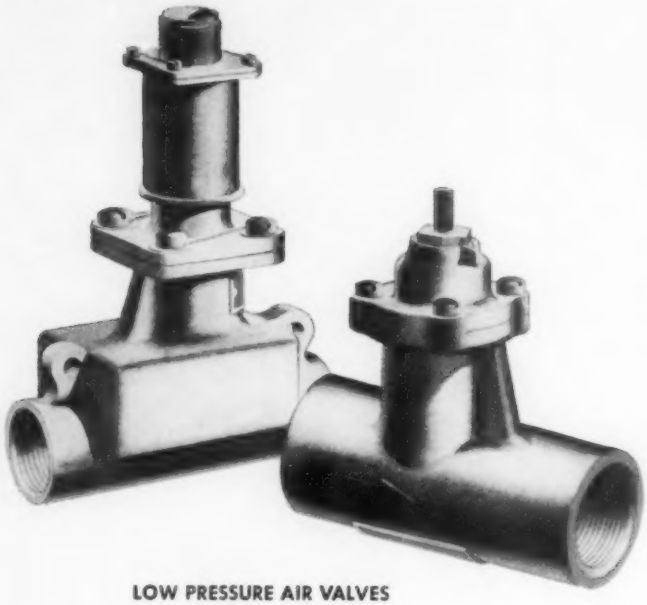
Prompt **PRODUCTION**



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ferred by Donner Trusts, making a holding

Avco Forms Air Weapons Team

A team of scientific consultants on nuclear energy, guided missiles and avionics has been formed by Avco Manufacturing Corp. to work on current research projects that include an intercontinental ballistics missile and a part of the continental air defense program.

Scarcity of top scientific personnel in the fields required for new aerial weapons development and supersonic aerodynamics has forced industry to employ the few available experts on a consultant basis. This is the second group of scientific advisors assembled by the aircraft industry in the last month. Convair recruited an advisory team to assist in development of missile systems and aircraft and to study nuclear research problems (AW Mar. 21, p 16).

▶ **'Important Frontiers'**—Victor Emanuel, Avco board chairman and president, said the assembling of the scientific groups started more than a year ago when the company decided to participate in advanced scientific weapons programs.

Avco's activities have been extended to "important frontiers in atomic energy and related fields, with our enlarged scientific staff as a fundamental part of current and forthcoming corporate operations."

▶ **Hypersonic Research**—Dr. Arthur R. Kantrowitz, professor of aeronautical engineering at Cornell University's Graduate School of Engineering, is directing research in the field of hypersonic aerodynamics relating to missiles. He is an authority on the application of molecular and atomic phenomena to high-speed aerodynamics.

Consultants include:

• **Physical chemistry.** Dr. Simon H. Bauer, professor of chemistry, Cornell University, former member of the office of Scientific Research and Development, and formerly with the Atomic Energy Commission.

• **Theoretical physics.** Dr. Hans A. Bethe, formerly chief of the Theoretical Physics Division of the Los Alamos Laboratory, who contributed to the development of the atomic and hydrogen bombs.

• **Theoretical physics and chemistry.** Dr. Peter J. W. Debye, recipient of the Nobel Prize in chemistry for his original contributions in the field of molecular structure.

• **Chemistry.** Dr. Clifford C. Furnas, chairman of the Technical Advisory Panel on Aeronautics, Defense Department, former Director of the Cornell Aeronautical Laboratory, and now chancellor of the University of Buffalo.

• **Mathematics.** Dr. Mark Kac, former member of the Office of Scientific Research and Development and currently professor at Cornell University.

• **Radar.** Dr. John Ruze, former assistant chief of the Antenna Laboratory, Air Force Cambridge Research Center, and now president, Radiation Engineering Laboratories.

• **Aeronautical engineering.** Dr. William R. Sears, member of the Naval Research Advisory Committee, and director of the Graduate School of Aeronautical Engineering at Cornell.

Copter Target Tug

An electronic target, approximately 15 ft x 6 ft., is towed aloft by a Royal Canadian Navy Piasecki HUP-3 helicopter. The target is attached to a cable unreeled from the copter's rescue hatch. The HUP-3 is based on the aircraft carrier HMCS Shearwater.

SEC Lists Aircraft Stock Transactions

Securities & Exchange Commission reports the following transactions of aviation stocks from Feb. 11 to Mar. 10:

Aero Supply Manufacturing Co., Inc. Acquisition of 200 common shares by Henry A. Rudkin, director, making a holding of 200.

Air Associates, Inc. Acquisition of 980 common shares by Gill Robb Wilson, director, making a holding of 1,030; disposal of 4,281 shares of 6% cumulative convertible preferred by Hillsboro Plantation, leaving no holdings; acquisition of 4,281 shares of 6% cumulative convertible pre-

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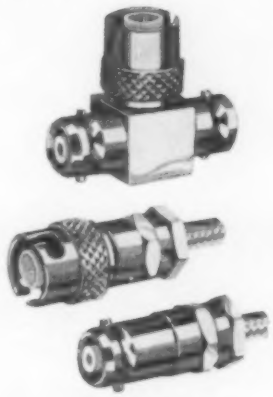
of the Standard BNC!



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TITANIUM

North American Super Sabre, F-100, uses Mallory-Sharon titanium and titanium alloys

Diet of titanium
SAVES WEIGHT, ADDS MUSCLE

SAVING weight is a goal almost fanatically pursued by aircraft designers. The reason is simple. By reducing the total weight of an aircraft by one pound, an additional *five pounds* of airframe structure can be eliminated. This saving can be translated into extra speed, range, or firepower.

Thus, in the latest fighter planes like the F-100, lightweight titanium replaces steel to yield weight savings in the hundreds of pounds. In the near future, titanium will save thousands of pounds per plane. This can mean the difference between first rate and second rate, between winner and loser.

Mallory-Sharon is a leading producer of titanium . . . supplying virtually every major aircraft and jet engine manufacturer with sheet, strip, bars, forgings, and other mill products. Use our experience in your applications of lightweight, corrosion-resistant titanium.

Mallory-Sharon Titanium Corporation, Niles, Ohio.

MALLORY Ti SHARON

ferred by Donner Trusts, making a holding of 14,281.

Alaska Airlines, Inc. Acquisition of 400 common shares by Frank C. LaGrange, director, making a holding of 6,800.

Allegheny Airlines, Inc. Acquisition of 500 common shares by William Zeckendorf, director, making a holding of 50,000.

American Airlines, Inc. Acquisition of 1,100 common shares through exercise of option by A. R. Bone, Jr., officer, making a holding of 2,700; acquisition of 5,000 common shares through exercise of option by O. M. Mosier, officer and director, making a holding of 9,000; disposal of 10,000 common shares by C. R. Smith, officer and director, leaving a holding of 44,000; disposal of 1,000 shares of 3½% convertible preferred by Edgar M. Queeny, director, his total holding.

Bell Aircraft Corp. Disposal of 200 common shares by Page Hufty, director, his total holding; disposal of 5,500 common shares by Ray P. Whitman, officer and director, leaving a holding of 7,500.

Bellanca Aircraft Corp. Disposal of 15,000 common shares by August T. Bellanca, director, leaving a holding of 1,000; acquisition of 500 common shares by F. Leroy Hill, director, making a holding of 1,000; disposal of 4,000 common shares by John Charles Redmond, director, leaving a holding of 1,500; disposal of 500 common shares by James J. Sullivan, director, his total holding.

Bendix Aviation Corp. Acquisition of 535 common shares by Marvin A. Heidt, officer, making a holding of 1,077.

Borg-Warner Corp. Acquisition of 900 common shares by E. Swain Russey, director, making a holding of 2,556.

Braniff Airways, Inc. Acquisition of 2,000 common shares by William A. Blakley, director, making a holding of 66,605; acquisition of 300 common shares by Eugene C. Eppley, director, making a holding of 6,800; disposal of 1,000 common shares by Thomas F. Ryan III, director, leaving a holding of 40,500.

Capital Airlines, Inc. Acquisition of 600 common shares by Crawford Johnson, Jr., director, making a holding of 705; acquisition of $5,000 of 3½% convertible income debentures by Raymond G. Lochiel, officer, his total holding.

Cessna Aircraft Co. Disposal of 2,000 common shares by F. A. Boettger, officer and director, leaving a holding of 3,000; disposal of 2,300 common shares by Dwane L. Wallace, officer and director, leaving a holding of 63,250.

Continental Air Lines, Inc. Acquisition of 600 common shares by Stanley O. Halberg, officer, making a holding of 800; acquisition of 100 common shares by S. B. Redmond, officer, making a holding of 575; acquisition of 1,000 common shares by Joseph A. Uhl, officer and director, making a holding of 2,317.

Douglas Aircraft Co. Acquisition of 50 common shares and disposal of 100 common shares by A. M. Rochlen, leaving no direct holding and an indirect of 50.

Fairchild Engine & Airplane Corp. Disposal of 125 common shares by George P. Chapline, officer, leaving a holding of 500; disposal of 2,500 common shares by Grover Loening, director, leaving 10,000.

General Dynamics Corp. Acquisition of 400 common shares by George W. Codrington, director, making an indirect holding of 2,000; acquisition of 1,000 common shares by Robert P. Meiklejohn, officer,

Salesmen Carry Radios

Japan Air Lines' passenger and cargo sales managers in New York are carrying high-frequency pocket radio receivers to keep in touch with JAL's switchboard after office hours.

The airline is the first to use this device as a customer service aid.

V. I. P.

VERY IMPORTANT PILOT

In him are combined the training, the scientific knowledge, the personal qualities that fit him to be master of a screaming fury that is faster than sound, faster than human senses. As he flies, electronic "crewmen" wait on him every mile and every moment. They peer through the dark, give him voice contact with far-away places, pinpoint his targets, fire his guns, tell him where he is . . . extend the power of arm and brain a thousand times. To speed his mission, bring him back surer and sooner, to enlarge his opportunities—RCA has assembled many of the world's foremost engineers and scientists. Their job is to study the pilot's needs, hear his viewpoint and search everlastingly for new and better electronic aids for him. And what they do for the pilot, they do for others in the armed forces—on land, at sea and in the air.

RCA

GOVERNMENT DEPARTMENT
RADIO CORPORATION of AMERICA
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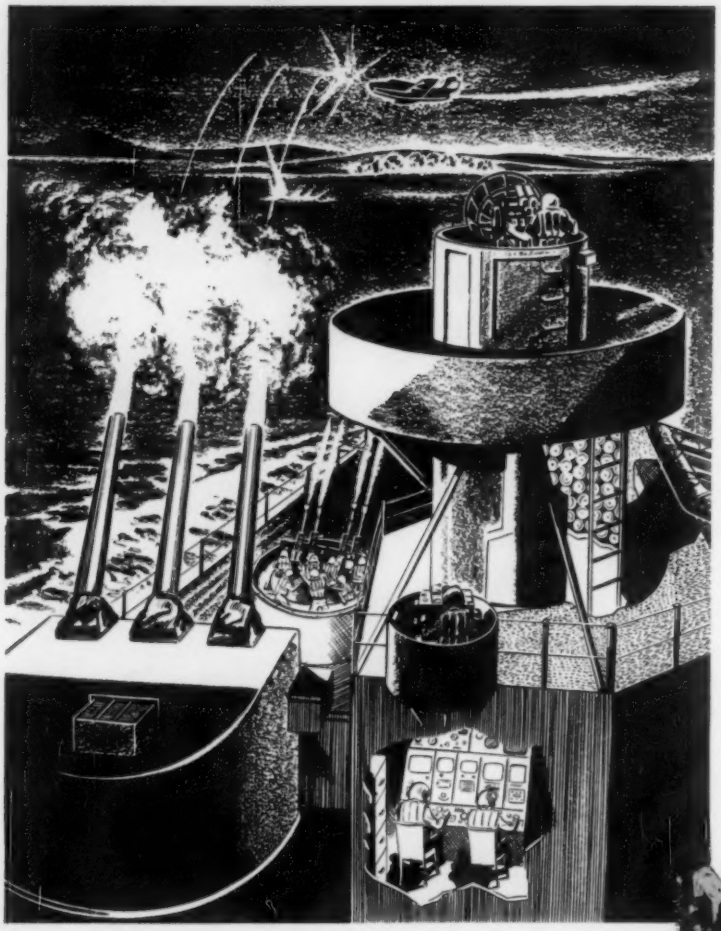

Atlas Built Parallax Correcter Helps Keep Guns

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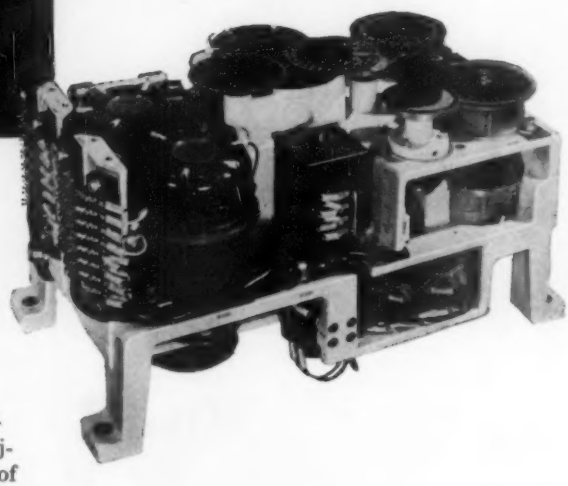

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From pilot stage to production efficiency of electro-mechanical equipment the leaders rely on Atlas "creative engineering." Atlas Precision Products Co., Philadelphia 24, Pa. (Division of Prudential Industries).

Write for booklet "Precisioneering Electro-Mechanical Equipment."

"From Drawing Board . . . to Production Line"

SERVICE ATLAS DEPENDABILITY QUALITY

ATLAS
Precision Products

making a holding of 3,105; acquisition of 3,605 common shares by J. Geoffrey Notman, officer and director, making a holding of 3,705.

Hoffman Electronics. Acquisition of 668 common shares through exercise of option by Howard C. Briggs, director, making a holding of 2,000; acquisition of 250 common shares through exercise of option by Joseph S. McGee, officer, making a holding of 250.

Lear, Inc. Acquisition of 234 common shares through incentive bonus plan by H. C. Andrus, officer, making a holding of 3,003; acquisition of 506 common shares through incentive bonus plan by F. D. Beamer, officer, his total holding; acquisition of 235 common shares through incentive bonus plan by Roy J. Benecchi, officer, making a holding of 590; acquisition of 106 common shares through incentive bonus plan by Vernon B. Benfer, officer, making a holding of 306; acquisition of 256 common shares through incentive bonus plan by Albus Durham, officer, making a holding of 256; acquisition of 372 common shares through incentive bonus plan by Philip E. Golde, officer, making a holding of 7,609; acquisition of 396 common shares through incentive bonus plan by A. G. Handschumacher, officer, making a holding of 5,896; acquisition of 138 common shares through incentive bonus plan by Albert C. Keske, officer, making a holding of 785; disposal of 1,000 common shares by William P. Lear, director and beneficial owner, and acquisition of 917 common shares through incentive bonus plan, leaving a holding of 406,341; acquisition of 622 shares of common shares through incentive bonus plan by Richard M. Mock, officer, making a holding of 17,155; acquisition of 3,103 common shares through incentive bonus plan by Paul Moore, officer, making a holding of 3,113; acquisition of 222 common shares through incentive bonus plan by George K. Otis, officer, his total holding; acquisition of 115 common shares through incentive bonus plan by Albert A. Rorison, officer, his total holding; acquisition of 103 common shares through incentive bonus plan by Chester D. Seftenberg, officer, making a holding of 103; acquisition of 157 common shares through incentive bonus plan by Dean C. Smith, officer, making a holding of 224; acquisition of 1,000 common shares by Russell A. Stevenson, director, making a holding of 1,200.

Lockheed Aircraft Corp. Disposal of 500 capital shares by H. R. Campbell, officer, leaving a holding of 650; disposal of 500 capital shares by Daniel J. Naughton, officer, leaving a holding of 1,719; disposal of 102 capital shares by Willard W. Keith, director, leaving a holding of 1,000.

McDonnell Aircraft Corp. Acquisition of 100 shares of Class A common by James E. Webb, director, making a holding of 200.

Minneapolis-Honeywell Regulator Co. Disposal of 300 common shares by C. B. Sweatt, officer and director, leaving a direct holding of 40,135 and an indirect holding of 4,200.

Northrop Aircraft, Inc. Disposal of 2,400 common shares by William B. Collins, director, leaving a holding of 4,000; disposal of 600 common shares by George T. Johnson, officer, leaving a holding of 32.

Northwest Orient Airlines, Inc. Acquisition of 10,000 common shares by Croil Hunter, director, making a holding of 14,050.

Pacific Northern Airlines. Acquisition of 500 common shares by Joseph H. Foster, officer, making a holding of 1,900.

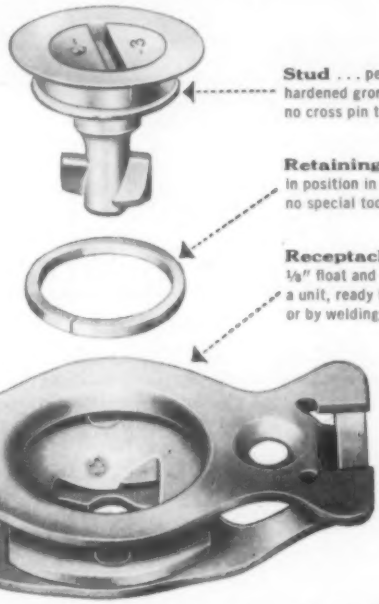
Pan American World Airways. Disposal of 2,149 common shares by Wilbur L. Morrison, officer, leaving a holding of 8,212.

Ryan Aeronautical Co. Disposal of 1,000 capital shares by Melvin H. Lockett, director, leaving a holding of 1,000; acquisition of 200 capital shares and disposal of 500 capital shares by Earl D. Prudden, director, leaving a holding of 4,700; disposal of 100 capital shares by G. C. Woodward, officer and director, leaving a holding of 100.

Seaboard & Western Airlines, Inc. Disposal of 1,000 common shares by Carl D.

New "Style 3" Panel Fastener!

PANELOC introduces Light-Weight, All-Steel Model, Setting Superior Standards in Tension and Shear at a new low price! Only three simple parts to inventory.



Stud . . . permanently assembled to a hardened grommet, comes as one unit, no cross pin to loosen or fall out.

Retaining Ring . . . locks stud assembly in position in one simple operation with no special tools required.

Receptacle . . . all steel, with full 1/8" float and 1" rivet spacing. Comes as a unit, ready for mounting with two rivets or by welding.

Exceptional durability, low price, and simplicity make the new fastener a newsworthy item. It conforms to Specification MIL-F-5591A and is interchangeable with all other "Style 3" fasteners. Let us send you a detailed catalog on the lightest, strongest, most economical "Style 3" Fastener available today.

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43 Mill Street, Waterbury 20, Connecticut
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Send to:
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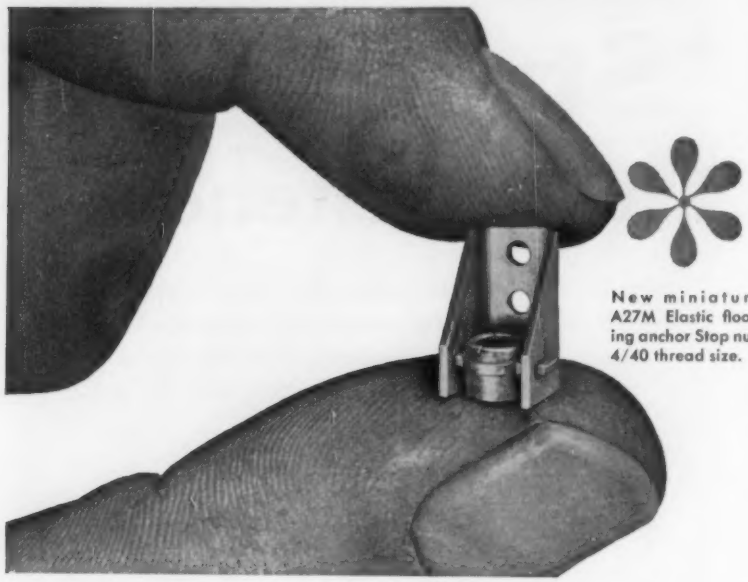
FASTENER PROBLEM

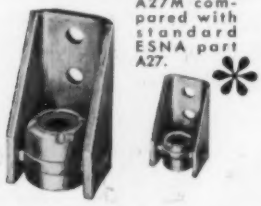


New miniature A27M Elastic floating anchor Stop nut, 4/40 thread size.

Special fastening methods required by miniature electronic subassemblies

Extension of aircraft weight reduction programs to include the electronic units carried by the air frame has resulted in miniaturization of component subassemblies and parts. Standard sized fasteners would defeat the purpose of the program and are impractical because the smaller units have insufficient space to permit efficient handling and wrenching. The necessity for "blind-mounting" components or cover plates presented further difficulties, particularly in production and maintenance, because of minor subassembly misalignments. ESNA engineers were asked to design a reduced dimension anchor nut to meet these special requirements.

The new miniature A27M Elastic Stop nut is a right angle floating anchor nut, with envelope dimensions as small as .344" x .455". It permits minimum mounting area and, because of its "float," engages easily in spite of minor misalignment of components.



Actual size photo of new A27M compared with standard ESNA part A27.

Like all Elastic Stop nuts, the A27M is self-locking, vibration-proof and reusable. As a "stop" nut the tight grip of the red elastic locking collar maintains a precise adjustment of a bolt at any predetermined point along its threaded length. And it is far simpler and less expensive to assemble than double nuts or soldered units.

MAIL THE COUPON FOR DESIGN INFORMATION

ESNA

Elastic Stop Nut Corporation of America
Dept. N72-425, 2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastener information:

☐ Details on Miniature A27M Floating Anchor

☐ Details on Type 1660 Miniature Hexagon Nuts.

Name_____ Title_____

Firm_____

Street_____

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Breil, officer, leaving a holding of 27,525; disposal of 900 common shares by Harold Montee, officer, leaving a holding of 10,676; disposal of 700 common shares by Wallace P. Neth, officer and director, leaving a direct holding of 426 and an indirect holding of 26,549; disposal of 100 common shares by Arthur V. Norden, officer and director, leaving a holding of 26,021.

Solar Aircraft Co. Acquisition of 200 common shares by Ewart W. Goodwin, director, making an indirect holding of 310; acquisition of 3,085 common shares by Herbert Kunzel, officer and director, making a holding of 3,415; acquisition of 1,500 common shares by L. T. Noel, officer and director, making a holding of 2,000; acquisition of 4,500 common shares by Edmund T. Price, director making a holding of 18,721.

Sperry Corp. Disposal of 1,500 common shares by Thomas B. Doe, director, leaving a holding of 4,500; acquisition of 1,000 common shares by Norman B. Frost, director, making a holding of 2,000; disposal of 1,500 common shares by K. R. Herman, officer, leaving a holding of 1,500.

Thompson Products, Inc. Acquisition of 14,300 common shares through exercise of option by James H. Coolidge, officer and director, making a holding of 25,586; disposal of 500 common shares by Frederick C. Crawford, director, leaving a holding of 41,084; acquisition of 660 common shares through exercise of option by E. H. Jones, officer, his total holding; acquisition of 3,080 common shares by R. S. Livingstone, officer, making a holding of 5,860; disposal of 7,588 common shares by S. Livingston Mather, director, leaving a holding of 24,488; disposal of 400 common shares by Horace A. Shepard, officer, leaving a holding of 1,800; acquisition of 17,600 common shares through exercise of option by J. D. Wright, officer and director, making a holding of 22,038.

United Air Lines. Acquisition of 100 common shares by Paul A. Bissinger, director, making a holding of 300; disposal of 1,300 common shares by Gardner Cowles, director, for Register & Tribune Co., beneficiary, leaving no direct holding and an indirect holding of 1,000.

Waco Aircraft Co. Disposal of 1,000 common shares by H. R. Perry, officer, leaving a holding of 50.

Western Air Lines, Inc. Acquisition of 2,500 common shares through exercise of option by C. J. J. Cox, officer, making a holding of 2,950; acquisition of 2,500 common shares through exercise of option by Terrell C. Drinkwater, officer and director, making a holding of 5,500; acquisition of 2,500 common shares through exercise of option by D. P. Renda, officer, making a holding of 2,501; acquisition of 2,500 common shares through exercise of option by Stanley R. Shatto, officer and director, making a holding of 3,500; acquisition of 2,500 common shares through exercise of option by Paul E. Sullivan, officer, making a holding of 7,500; acquisition of 2,500 common shares through exercise of option by J. J. Taylor, officer, making a holding of 2,850.

Westinghouse Electric Corp. Disposal of 239 common shares and acquisition of 402 common shares by Mark W. Cresap, Jr., officer, making a holding of 1,627; disposal of 300 common shares by A. M. Robertson, officer and director, leaving a holding of 200; acquisition of 211 common shares by C. S. Weber, officer, making a holding of 793.

Correction

Charles B. Sweatt, vice chairman of the board, Minneapolis-Honeywell Regulator Co., possessed 40,435 shares of the company on Jan. 31. Quoting an error in the Security & Exchange Commission summary, AVIATION WEEK (Apr. 4, p. 28) reported Sweatt had disposed of his total holdings.

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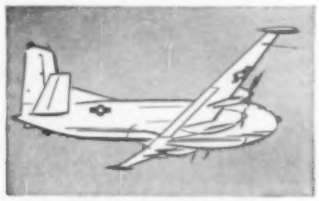
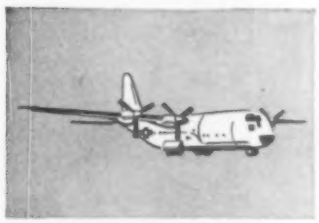


DOUGLAS YC-124B
long-range transport
for the U.S. Air Force

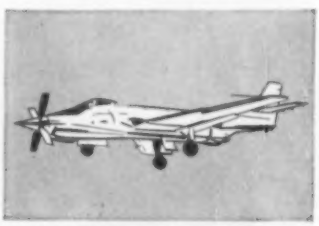
CONVAIR XFY-1
vertical take-off fighter
for the U.S. Navy

LOCKHEED XFV-1
vertical take-off fighter
for the U.S. Navy



BOEING KC-97J
USAF long-range
tanker transport

BOEING XB-47D
long-range bomber
for the U.S. Air Force



McDONNELL XF-88B
USAF experimental Turbo-
prop fighter type aircraft

REPUBLIC XF-84H
USAF experimental Turbo-
prop fighter type aircraft

LOCKHEED YC-130
USAF high-performance
air freighter

Delivered in Quantity for
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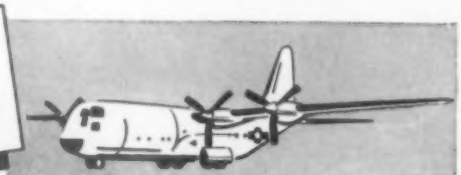

LOCKHEED C-130A USAF high-performance air freighter

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T-38 used in the XF-88B	**T-34** used in the YC-124B, KC-97J	**T-40** used in the XFV-1, XFY-1, XF-84H
T-49 used in the XB-47D	**T-56** used in the YC-130, C-130A	

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5. Available in 28 V and 115 V DC or in 28 V and 115 V 400 cycle AC

6. 1.50" dia. (Type 3094) illustrated. Variations include 1.25" dia. (Type 3101), 1.062"* dia. (Type 3200) and 1.75"* dia. (Type 2487).
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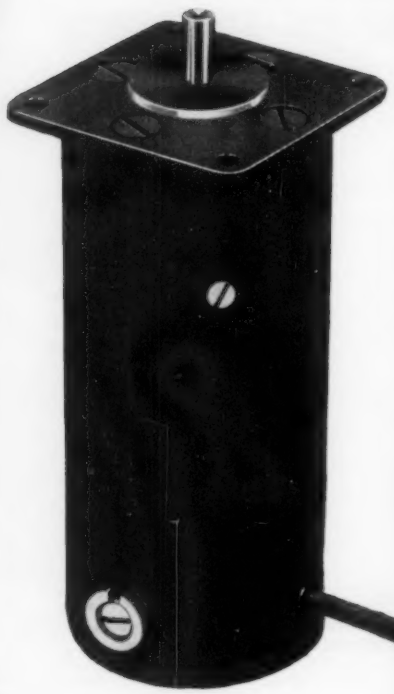

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Engineers Team With Doctors To Make Pilot's Job Easier

By David A. Anderton

All the information a pilot needs on his mission is presented by five indicators in a new instrumentation approach developed by Hughes Aircraft Co., Culver City, Calif.

Two vertical indicators show speed and altitude information; two circular scopes indicate airplane attitude, direction, terrain, weather and collision warning data; the fifth presentation is a circular navigational aid with a moving airplane marker plotted over a fixed chart of the mission area.

First showing of the new system—a highlight of the Aero Medical Assn.'s 26th annual meeting in Washington, D. C.—emphasized the first active participation of the aircraft industry in the association's biggest scientific meeting.

▶ **Engineering and Medicine**—The importance of aviation medicine to the aircraft designer and engineer was further underscored by:

• **Test-pilots' symposium,** moderated by Brig. Gen. Donald Flickinger, USAF (MC), and including comments by Scott Crossfield, NACA; Maj. Arthur Murray and Lt. Col. Frank Everest, USAF; Robert Rahn, Douglas Aircraft; Robert DeHaven, Hughes; Don Rogers, Avro Aircraft, Canada. Common observation: Most personal gear is uncomfortable.

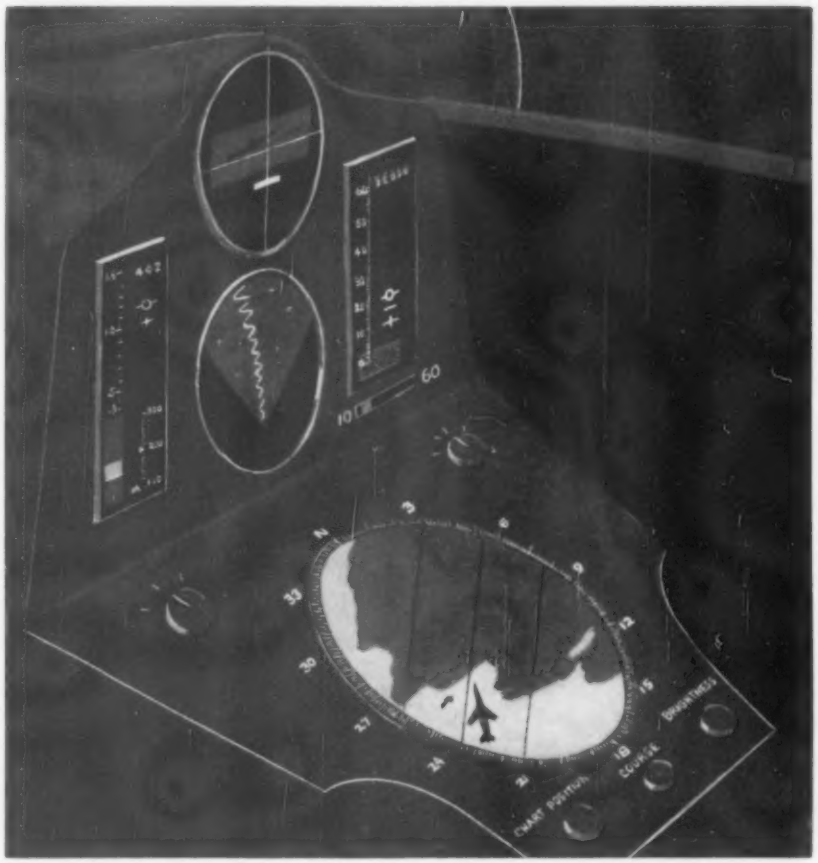
• **Special session on space medicine,** outlining some of the problems of the next huge area of aircraft design.

• **Equal prominence of medical and engineering papers** presented during the meeting, with the idea of introducing doctors to engineering problems and engineers to medical aspects of flight.

Hughes Cockpit

Radar data and presentation are the heart of the Hughes instrumentation layout. They furnish steering signals, navigational plotting, altitude and some speed information.

Four of the five indicators—speed, altitude, steering and PPI presentations—are mounted in the conventional manner on a vertical panel in the cockpit. The fifth—navigational aid—is on a flat console about where a pilot might place his chartboard.



FUTURE COCKPIT layout developed by Hughes Aircraft Co. engineers replaces current mass of instrumentation with five indicators to present all primary flight data.

Other equipment in the cockpit would be the gunsight or other fire control apparatus, a selector and film file of the charts for navigation, and the standard engine controls.

Presentation is of the "howgozit" type—the pilot sees an "ideal" indication and flies to match it with another indicator. This system frees him from reading a numerical value, comparing it mentally with an "ideal" or limiting value, and then making necessary flight corrections. Supplementary information includes numerical values.

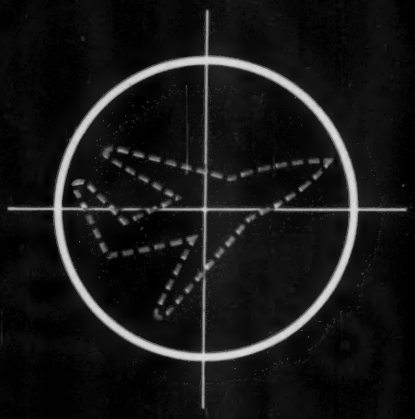
▶ **Speed Data**—A vertical "slide-rule" indicator presents the speed information to the pilot. He sees against a graduated Mach number scale a circular indicator which marks the mission requirement fed to him from ground control. He jockeys the throttle to match that indicator with a crossed marker representing his actual flight performance.

A counter-drum indicator above the markers gives him a true airspeed reading during normal flight.

Approach and landing information is presented at the bottom of the scale. The left-hand side has a vertical stripe colored green, yellow and red, with the green area at the top. As the plane slows through its landing path, an indicator moves down the scale, indicating the proximity to stall.

The right-hand side has a scale of indicated airspeed with a marker for the pilot to read during landing.

▶ **Altitude Data**—A similar presentation gives the pilot altitude information. A vertical scale of altitudes is the reference for a circular marker giving com-



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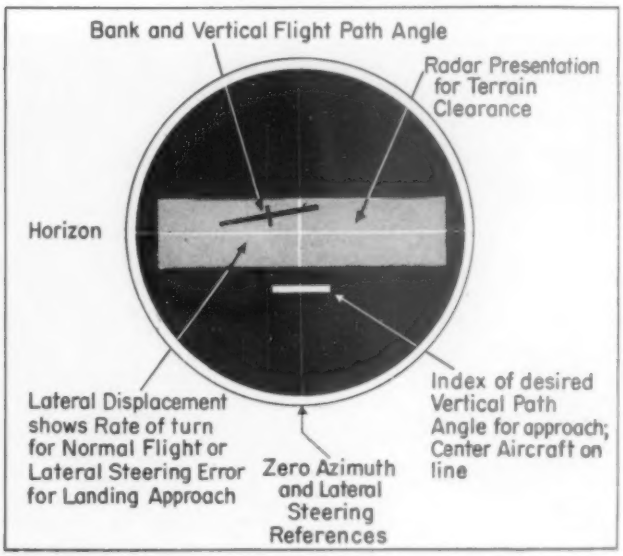
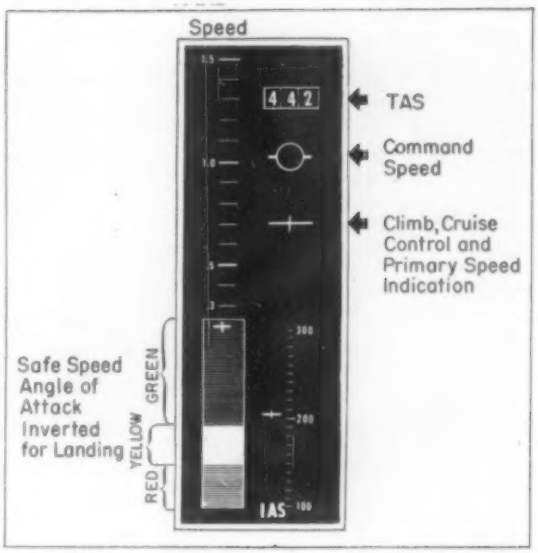

Bank and Vertical Flight Path Angle
Radar Presentation for Terrain Clearance
Horizon
Lateral Displacement shows Rate of turn for Normal Flight or Lateral Steering Error for Landing Approach
Zero Azimuth and Lateral Steering References
Index of desired Vertical Path Angle for approach; Center Aircraft on line

STEERING information is presented by this scope in the Hughes simplified panel. Attitude, terrain clearance, flight path angles and approach data are given.



SLIDERULE indicator gives speed information (above) and also altitude (on separate presentation). Command speed is set in by ground control of mission.

mand information from the ground, and a cross marker giving the plane's position.

A scale selector at the bottom of the indicator changes the altitude scale from a range of 0 to 60,000 ft. to a range of 0 to 10,000 ft.

A drum counter gives a direct indication of exact altitude to the nearest 100-ft. mark.

A third marker on the scale presents, in effect, rate of climb information. It represents the altitude that the airplane will reach one minute from the time it is read.

A superimposed screen at the bottom moves with the terrain-clearance information and gives the pilot a quick visual check of his height above the ground.

▶ **Where To?**—Attitude, steering and flight path information is presented on a single scope of about 6-in. dia. It has a nearly solid black face with white crosshairs. A space-stabilized gated C-scan radar presentation occupies a central horizontal band. Superimposed on this band is a cross marker representing the airplane.

From the position and attitude of the cross marker, the pilot reads bank and vertical pitch angles. Its displacement from the centerline gives him his flight path angle, the rate of turn for normal flight or his lateral steering error during a landing approach with an instrument system.

Superimposed on the face of the scope is a short horizontal barline indicator that is matched by the airplane marker during approach. It is positioned by information from the ground radars controlling the flight path, and is an index of the desired vertical path angle for approach.

This single presentation replaces the standard artificial horizon, the cross-pointer indicator, the Zero Reader, and the turn-and-slip indicator.

▶ **Warnings**—The second scope presentation on the vertical panel is a sector PPI radar plot that shows the position of other aircraft, weather and terrain features in approximately a 90-deg. sector ahead of the airplane.

Most complex presentation is the navigational aid, which replaces—say the Hughes engineers—the ID250 course indicator, Zero Reader, DME, clock, maps, charts, the E-6B computer and navigational plotters.

The navigational information is on a circular scope superimposed on a fixed chart of the mission area. The charts are stored on 70-mm. film and selected by the pilot. Storage reel will handle about 100 ft. of film, which could correspond to about 400 individual charts.

The pilot selects the course mode—ADF, command, etc.—and positions the course overlay which gives him the course to fly. A small indicator represents his plane, and "flies" over the fixed chart in a continuous plot of VOR/DME information and heading.

Separate control knobs enable the pilot to enlarge the chart two magnifications, or to select one of three scales —1:375,000, or 1:750,000 or 1:1,500,000—for the presentation of the chart. Brightness, chart position and course control are also knob-operated.

Pilot Panel

Comments on deficiencies in personal equipment—clothing, helmets, oxygen gear—predominated in the often-acid remarks of the six test pilots. Maj. Arthur Murray fired the first shot by saying that USAF was seriously worried about degradation of the pilot's efficiency because of the equipment he is given. These are some of the other comments:

• **On clothing:** "The pilot wears enough clothing to open a war-surplus store. . . . I just can't wait to get down and take the T-1 (partial-pressure suit) off. . . . I can't fly with the thing on. . . . I can't reach the fuel controls in the F-102 with the T-1 suit on. . . . The A4D integral suit is great, and I like it, but you can't wear it with the T-1 or with the Mk. 4 (immersion suit)."

• **On equipment:** "Safety belts and harness are just marginal on comfort. . . . A13A oxygen mask is critical on dirt, but it may be on the way out. . . . It's hard to get rid of your chute readily after bailout."

• **On training:** "Pilot comments are not fed back into training soon enough. . . . Aeromedical indoctrination is up-to-date, but escape indoctrination is seriously behind the times. . . . Control simulators are excellent, but nothing can simulate highspeed flight near the ground."

• **On flight problems:** "There's no good way now to keep a pilot in business as long as he could be useful. . . . You can tell a pilot's age by noticing whether he cups his ears with one hand or two. . . . For high-altitude flight, we take the canister out (of the Bell X-1A) to get a little water vapor in the cockpit from our breath. That gives a little diffusion of light in the cockpit and reduces the extreme contrast. . . . We're now going to use pre-oxygenation for half an hour before flying above 40,000 ft. . . . Anybody who's going to fly over 50,000 ft. must wear the T-1."

Space Flight

Limits of flight at the upper border

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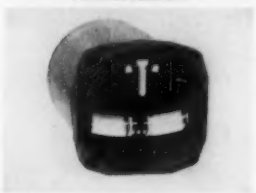
LINK—the name that has been synonymous with Flight Simulators and Trainers for more than twenty-five years—offers now a complete line of instruments designed to simulate faithfully the appearance and performance of corresponding airborne instruments.

Numerous organizations—manufacturers of simulators' aircraft procedural trainers and radar trainers as well as research laboratories—have learned that the dependable Link source of supply offers many cost-saving and time-saving advantages.

Accelerometers



Turn and bank indicators

Master direction indicator

These Link hi-precision mechanisms, which are powered by electro-mechanical means, incorporate:

- High speed response and accuracy utilizing easy-to-match synchros or servo motors.
- Tested designs that meet government specifications.
- Enclosed dust-free housings.
- 60 cycle, 400 cycle and DC designs.

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Accelerometers	Heading indicator
Airspeed indicators	Magnetic compass
Altimeters	Master direction indicator
Angle of attack indicators	Oil pressure indicator
Fuel flow indicators	Rate of climb indicators
Fuel quantity indicators	Tachometers
Gyro horizon indicators	Turn and bank indicators

And Link can supply special instruments with single or independent multiple indications with special dials to meet individual requirements.

Write today for specific data on any of these Link simulated aircraft instruments.

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Manufacturers of world-famous Link trainers and simulators (such as F3D, F-89, F2H-2, F2H-3) • simulated aircraft instruments • specialized computers • servo mechanisms computer components • gear boxes • friction over-drive clutches • precision potentiometers • ratio voltmeters • phase angle meters • and other electronic devices.

of the atmosphere were detailed by Dr. Walter R. Dornberger, missile consultant to Bell Aircraft Corp.

Dornberger's paper was one of eight devoted to the problems of flight in space and some of the progress made in understanding them. These new problems are tough ones, said Dornberger, but they don't appear insurmountable.

▶**Green Light**—A prototype spaceship cabin, completely sealed and with means for creating and maintaining its own atmosphere, has been developed for the USAF School of Aviation Medicine. Dr. Hubertus Strughold said that this kind of a cabin ". . . gives us the green light into space."

Two problems will come under study in the school's use of the cabin.

- Extent and direction of climatic changes by the presence of a crew in the cabin; counteracting these changes by physical, technical or biological means.
- Check out of crews in the problems encountered in such a closed ecological system, and the possibility of emergency situations.

The hazards of cosmic radiation in free space are being better understood as the result of high-altitude balloon and rocket flights made with fruit flies, mice, rats, hamsters, rabbits and monkeys.

Most interesting result: The mice have been getting gray-haired as a result of exposure.

Other effects—on nerve tissue, on vision (cataract-forming) and on mutations of genetic material—were studied. None of the results indicated that radiation has any effect that cannot be explained on the basis of current data.

Technical Papers

The basic equation for the efficiency of a man-aircraft combination (in other words, a possible weapon system) was defined by A. M. Mayo, one of the recognized authorities on human factors in engineering design in this country.

Mayo, who is chief of equipment and interiors for Douglas Aircraft's El Segundo Division, defined the overall efficiency as a product of the aircraft efficiency and the pilot efficiency. If either factor is low, then the overall efficiency of the combination is low.

▶**Often Overlooked**—This self-evident fact has too frequently been overlooked in the design stages of future aircraft weapon systems, and may help to explain the epidemic of accidents with recent high-performance planes. Said Mayo:

"There are strong indications . . . that man's limited time constants and strength prevent him from acting with the speed and force necessary to overcome malfunctions of a type that he might have relatively easily handled in

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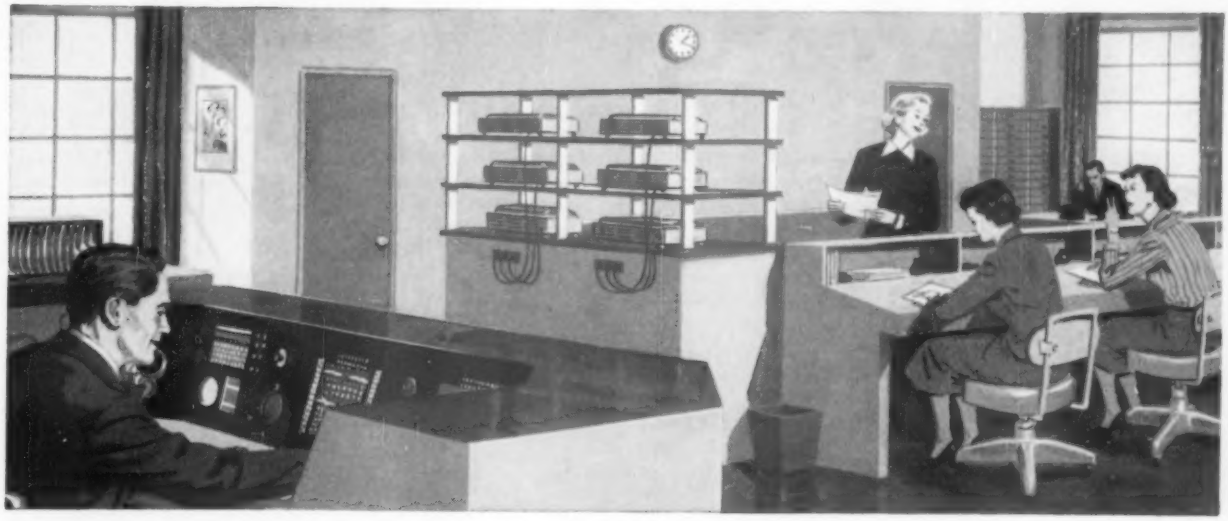

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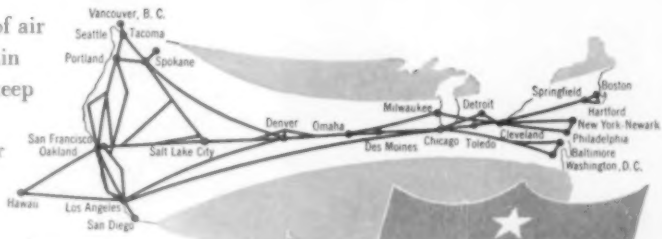

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VTO EJECTION tests are made with articulated anthropomorphic dummy. New Navy escape system for the unusual aircraft is completely automatic. Seat belt opens as seat is ejected; snubbing lines retain seat momentarily to guarantee separation of pilot from seat. Parachute pack is opened by static line. Tests indicate safe ejection at altitudes of 200 ft. at zero speed, less if the plane is going forward.

lower-performance aircraft. Additional emphasis on the design of accommodational aids for the pilot may reduce these accidents. Such emphasis might also increase overall effectiveness at a higher rate per unit expenditure than some of the more spectacular aerodynamic and mechanical advancements."

Mayo said the Navy's long-range instrument development program was pointed toward a system available in 1958. In the meantime, interim modifications were being cranked in.

Another plug for the Navy's program came from Lt. Cdr. George W. Hoover, of the Office of Naval Research. Hoover has long been known for his outspoken and vigorous championing of the pilot, and for his efforts in instrumentation development programs.

He pointed out that standardization of instruments panels was not yet possible; "instruments have traditionally been developed from experience with clocks and steam gages, and there won't be standardization until the instruments are adequate to be standardized," he said.

Hoover said instrumentation engineers had been so busy rushing off on "fire drills" that they never had a chance to sit down and study fire prevention.

▶ **Short-Range Improvements**—Interim developments in the Navy's program have produced a new type of fighter instrument panel with modified instruments, layout, lighting and painting.

These newer displays, said Navy scientists Fred R. Brown and William L. Lovejoy, give the pilot easier and more accurate performance with fewer demands upon his capacities.

A new directional-horizon is centered on the interim panel, and gives the pilot aircraft attitude and direction information. Other indicators have been reduced in size. Five instruments are completely new: Angle-of-attack indicator; the counter-pointer altimeter replacing the standard three-point unit; Mach number and airspeed indicator; radio altimeter indicator with a single scale range to 20,000 ft.; distance-bearing indicator, a dead-reckoning device giving navigational data not dependent on external radio signals.

▶ **VTO Bailing Out**—Getting out of a stricken VTO aircraft poses a series of different problems, with the most critical coming during the landing phase with the plane nearly vertical. Conventional ejection seat and manually operated chute would require about 500 ft. of altitude to guarantee reliable operation.

So the Navy has designed, tested and installed a completely automatic escape sequence for the Lockheed XFV-1 and Convair XFY-1. When the seat is ejected, the safety belt opens automatically. The seat is snubbed momentarily to separate the pilot from the seat. The parachute pack is opened by a static line.

If the pilot ejects at 200 ft. or higher, he'll make it to the ground with an inflated chute, even if the VTO aircraft has zero forward speed. If he has some forward speed, the minimum safe altitude decreases, until at 200 knots he can eject as low as 25 ft. off the ground.

Cdr. Roland A. Bosee and W. C. Buhler, of the Navy's Parachute Unit at El Centro, Calif., concluded their paper on VTO escape by pointing out that this method of seat and pilot separation seems to be a way to reduce ejection seat fatalities, and should be considered for all single-place aircraft.

▶ **Decelerations**—No person is more qualified to talk on the effects of deceleration and windblast on humans than Lt. Col. John P. Stapp, chief of the USAF Aero Medical Field Lab.

Stapp has hazarded his life time and again in agonizing tests aimed at understanding and solving the problems of highspeed escape. His coldly precise scientific language and unemotional presentations of the rocket rides along the highspeed tracks tell the story better than any paraphrasing could.

This is his description of one such test, with deceleration peaks of 35 and 40G, and an acceleration onset (rate of change of acceleration) of about 600G per second:

An hour and 20 minutes was consumed in accomplishing the fastening of all harness components and putting on the helmet. Straps were pulled unusually tight. The chest strap was tightened in the last 20 minutes of this time, and was pulled tight enough to restrain all rib motion in breathing. The diaphragm only was used in breathing from that time until the chest belt was removed at the end of the run.

The subject recalls taking in about half a breath and holding it from the countdown of five until the end of the run, or a total of about 12 seconds. Even allowing for the absence of a windshield, which would heighten the impression of speed, the acceleration was noticeably greater and the thrust of the seat against the subject's back more violent than in any previous run. The concrete ditch, which was clearly in focus between the rails before motion began, became a blurred image due to inability to focus and perhaps to vibration of the head rest and helmet.

At about the count of two, vision narrowed to the central fields only, and then by the count of three there was a visual blackout. This was strictly confined to the eyes, with no decrease in consciousness or feeling at this point. At the instant of burnout, the pressure of acceleration against the back instantly disappeared as forces were reversed, and the wind drag and rail friction effects decelerated the sled in the power-off phase at about 5.5 to 16.8G.

▶ **Deceleration Period**—The instant that the forces reversed, and harness pressure could be felt on strap impingement areas, there was a very rapid transition from black to yellow in visual perception, followed by a brief view of the track and water brakes,

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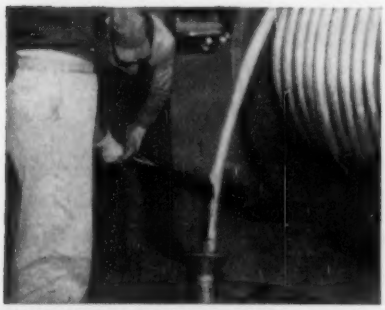

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Thinner Wing to Raise X-1 Mach Limit

somewhat like a stroboscopic flash, before entry into the water brakes threw the subject's body violently forward against the harness. Up to this point there is a vague recollection of wind pressure being felt as a fluttering of the shoulders of the coveralls, but no buffeting or unpleasant sensation.

On entry into the waterbrakes, the face immediately felt congested and severe pain was felt around the eyes, as though they were being dragged out of the sockets. Vision became a shimmering salmon-colored field with no images—evidently the pupils were impinged against the stretched upper eyelids and the visual sensation was due to light coming through the lids.

The congestion and pain increased noticeably during the exposure to more than 25G for more than one second. The eyes felt somewhat like the extraction of a molar without anesthetic. This pain was sufficient to override sensations caused by impingement on harness straps, even though late abrasions and contusions were visible at all strap pressure areas.

When the sled stopped, the visual impression of shimmering salmon color not only persisted, but was present when the eyes were forced open. There was a marked exophthalmos (protrusion of the eyeball) which made it difficult to open the eyes without using the fingers. The chest strap was so tight that it was extremely difficult to breathe. A mental confusion, something like that of struggling against the onset of anesthesia was present.

As soon as the chest strap was loosened and the bit block removed, normal respirations were possible and the confusion diminished. There was no loss of consciousness at any time. A piece of cotton, apparently with spirits of ammonia on it, was rubbed on the nose but the nasal passages were blocked and there was no sensation of smell. An oxygen mask was pressed on the subject's face, but was rejected with the request that attendants hurry up and get the straps loose. The subject insisted that he was all right, merely wanting to get out of there.

▶ **Return of Vision**—After the straps were removed the subject stood up but could not see to get off the sled, and was picked up by attendants and put on a stretcher. There the congestion of the eyes receded sufficiently to permit return of vision in an estimated eight and a half minutes after the run.

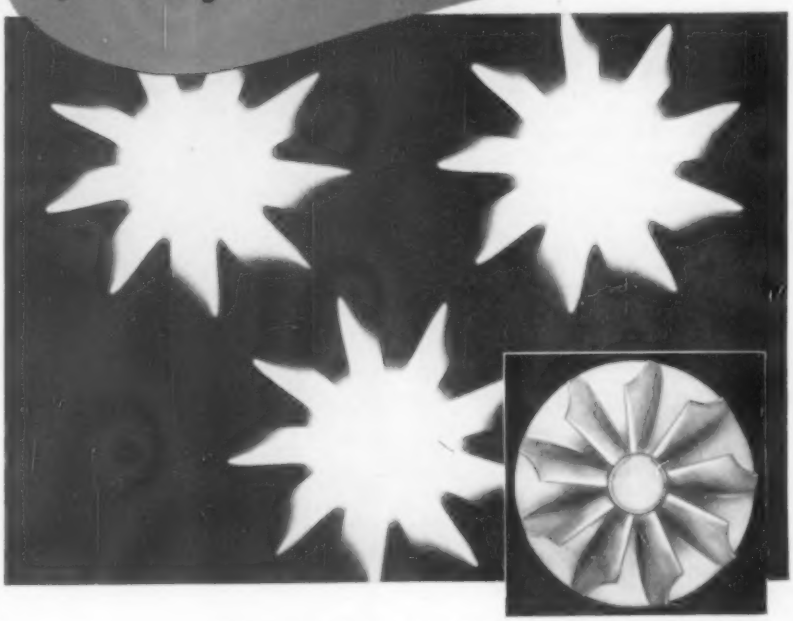
Central vision returned first, then peripheral, by intermittent patches of images of the sky which gradually persisted and coalesced into normal visual fields. There was diplopia (double vision) on moving the eyes, with gradual convergence if they were fixed on an object. This persisted for about three hours.

On the way to the hospital there was pain in the eyeballs that was at first considered to be due to increased intra-ocular tension, but this responded later to treatment with cold packs. There was no fuzziness of vision or sensations of retinal spasms such as had been experienced after a run in which there was retinal hemorrhage in 1951.

Aside from congestion of the nasal passages and blocking of paranasal sinuses, hoarseness and occasional coughing from congestion of the larynx, and the usual burning sensation from strap abrasions, there was only a feeling of relief and elation at getting the run over with, and at knowing that vision was unimpaired.

INSIDE STORY

Austenal Quality Control



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Thinner Wing to Raise X-1 Mach Limit

New, thinner wings, engineered and built by Stanley Aviation Corp., will replace the original panels of the Bell X-1 rocket-powered research vehicles. The new wings are 4% thick, compared with 10% on the old.

Drag reduction of the thinner surfaces is expected to extend the speed range of the research craft substantially above its present Mach 2.5 upper limit.

First set of panels is being installed in an X-1 at Edwards AFB, and the first flight with the new surfaces is scheduled for late this summer. A second set has been delivered to NACA at Langley Field.

▶ **The Problem**—Stanley engineers under project engineer Gordon Valentine were faced with a tough design problem:

The maximum wing thickness was only 3⅜ in. at the wing root. The wing had to take almost all of the loads of the original wing, although the available section depth was less than half the original value.

But the structural design wasn't the only problem. The Bell X-1 series are test vehicles, designed to get the maximum amount of flight information out of every minute they are in the air, so they are crammed with test instrumentation and data-recording equipment.

The thin wing surfaces had to have 343 baked-on plastic gages to measure structural strain and temperature. More than 200 pressure pickup orifices had to be imbedded in the wing surface and connected with remote manometers by more than 1,500 ft. of 5/32 OD aluminum tubing.

▶ **The Solution**—Area had to be kept the same on the new wing panels, but Stanley engineers were able to get an aspect ratio concession: The value was reduced to four from the original figure of six.

This meant that the wing root section still had to take about 80% of the bending moment imposed on the old wing panel, even though its actual thickness was less than half.

Primary consideration was given to aeroelasticity in the design; the combination of high Mach numbers and extremely thin wings is generally a critical one in that area. Torsional stiffness was maximized by designing all joints for minimum slippage so that there would be no "play" in the system.

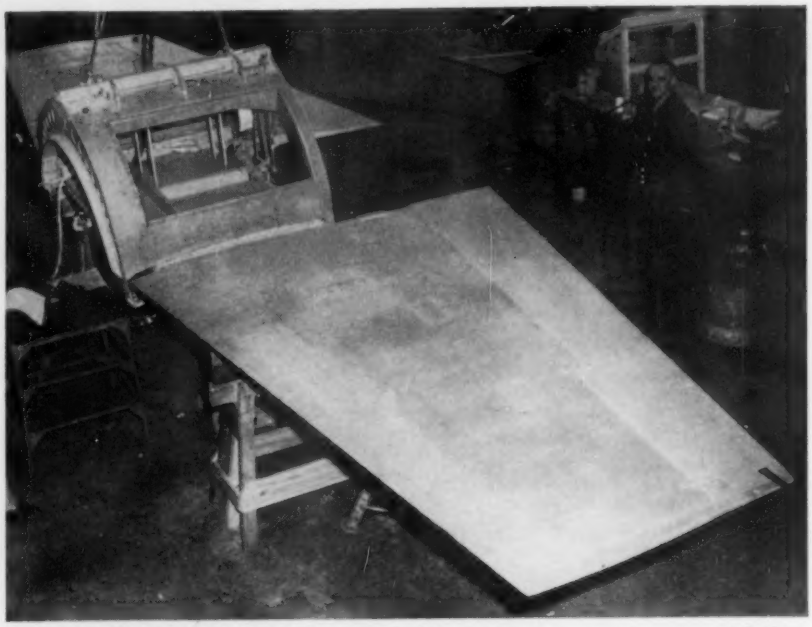
The final design is a multi-spar layout with tapered milled skins attached by bolts tapped into solid ribs and spars. Spars are of rectangular section and have no capstrips.

Maximum inside clear depth at the root is 2⅛ in.

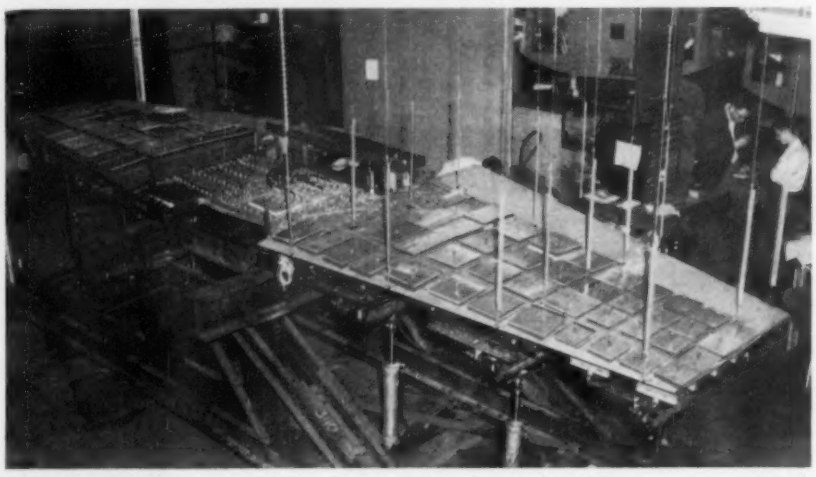
▶ **Historical Note**—Robert M. Stanley, president of Stanley Aviation, was Bell's vice president—engineering for the major portion of the X-1 development.

In a presentation before the Institute of the Aeronautical Sciences in 1947, Stanley described the development of the XS-1, as it was called then, and referred to the "quite thin" wing, and the unusual method of skinning (tapered milled skins) used to cover the XS-1 surfaces.

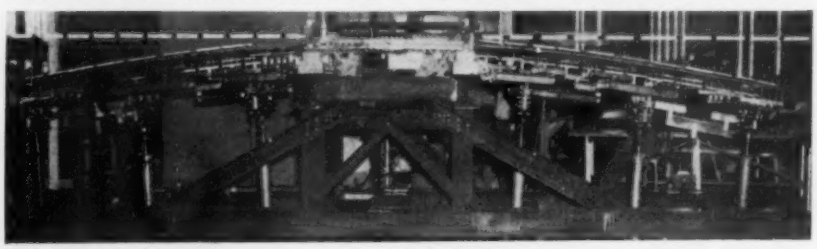
Now, 10 years after the design concepts that made the X-1, progress in the structural arts has enabled Stanley's engineers and designers to surpass the original limits of the XS-1 design.



NEW X-1 WING made by Stanley uses multi-spar layout, with tapered milled skins.

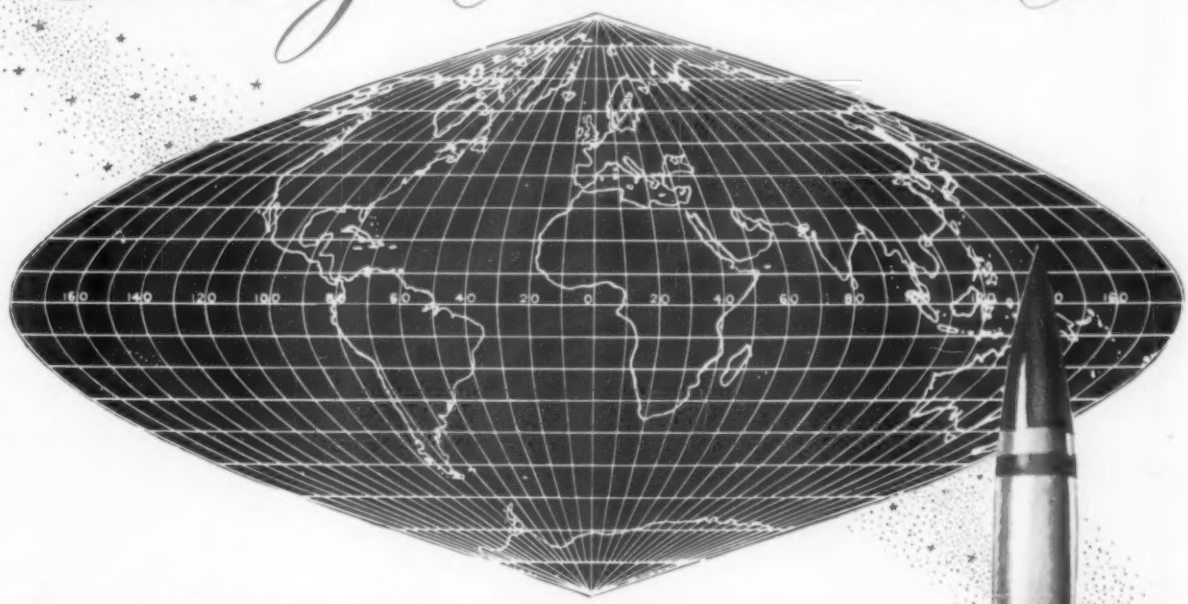


TENSION TESTS try new wing's strength. Aspect ratio is 4, down from previous 6.



DEFLECTION OF WING under static test is indicated by horizontal dashed line (top).

Ten Years That Changed the World



History records no more radical changes in the military sciences than those of the past decade. The period 1945-1955 saw not only the advent of nuclear weapons but, equally important, new systems of defense and new means of offense – guided missiles.

Just ten short years ago guided missiles were only a visionary concept. Today they are on the verge of becoming the base on which the security of Western Civilization and the peace of the world will rest. Although largely masked by the necessities of military security, tremendous strides are being made by all the branches of the U. S. Armed Forces in this crucial period.

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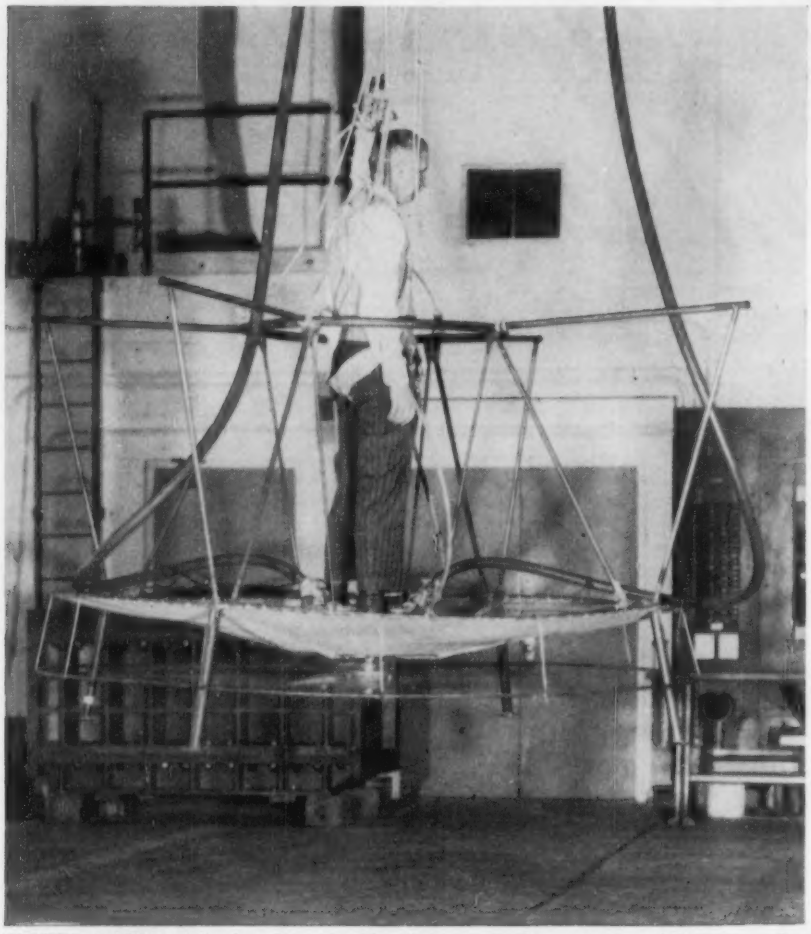
NACA Tests Lead to Flying Platforms



INDOOR FLIGHT TEST lasted up to 15 minutes. To demonstrate stability, flyer shot down row of tin cans with "beebee" gun while several feet in air. Photo below shows details.

NACA TEST VEHICLE has 7-ft. rotor and hand rail to support flyer, weighs 140 lb. Air jets at tips drive rotor. Two other jets correct torque created by rotor blades.

● Unusual one-man vehicles are payoff on 10-year research program; military services are interested.

Basic research leading to recently-announced flying platforms has been carried on for nearly ten years by National Advisory Committee for Aeronautics and one of its leading engineers, Charles H. Zimmerman.

Zimmerman, a pioneer in the vertical takeoff aircraft field and designer of the unique Chance Vought XF-5U-1, Navy carrier fighter known as the "flying pancake," holds a patent dated Mar. 25, 1947 for a "helicopter flying apparatus" that is fundamental to machines displayed in recent weeks by Hiller Helicopters (AW Apr. 18, p. 13) and de Lackner (AW Apr. 4, p. 7).

Not long after getting the patent, Zimmerman joined NACA at its Langley Laboratory, where the project was pursued until last year, when a report was issued on experiments with a platform supported by a teetering rotor.

▶ **Simple Device**—Earlier, in co-operation with Paul R. Hill and T. L. Kennedy, Langley researchers, Zimmerman built and flew a platform supported by a jet stream of air. Probably the simplest flying device since the kite, it consisted of a small piece of plywood fitted with welded steel tubing as a landing

SEQUENCE PHOTO shows model flown by remote control. Tiny vanes around bottom are for control, made necessary because dummy can't shift weight to steer vehicle.

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gear. A hose was fastened to the plat-

were made when the man on the plat-

A-MP TERMINALS for ALUMINUM wire #8 to 3/0

TERMALUM Terminals

A-MP TERMALUM Terminals overcome problems inherent in aluminum wire termination. All-aluminum TERMALUM Terminal has "cartridge" pre-loaded with special oxide removing and inhibiting compound. Confined crimp extrudes wire strands evenly and eliminates hot spots. During crimping, inhibitor is forced among strands and between insulation and terminal to form moisture barrier. The TERMALUM Terminal is suited for high ambient temperature and heavy current cycling applications. *Far exceeds all Military Specifications.*

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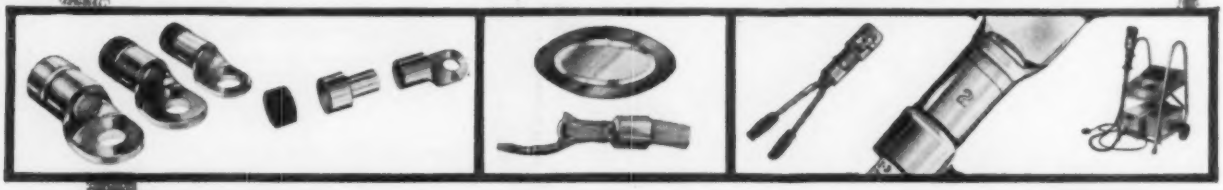
A-MP TERMALUM and COPALUM Terminals are available in wire size 8 to 3/0. Exploded view shows "cartridge" construction. Cartridge (center) fits in barrel (right). Color coded cap (left) retains inhibitor in cartridge until used.

Cross section shows evenly deformed strands and large contact areas of wires and terminal body.

Longitudinal view shows cartridge sealed at wire end and insulation supporting crimp

A-MP TERMALUM and COPALUM are applied with A-MP DYNA-CRIMP or Hand Hydraulic Tools. DYNA-CRIMP can be bench or cart mounted. Air-electric or foot Pump actuations are available with DYNA-CRIMP. DYNA-CRIMP is for wire sizes 8 to 3/0 and A-MP Hand Hydraulic is for wire sizes 8 to 4. Wire size is embossed on terminal during crimping. (SEE CLOSE UP.)



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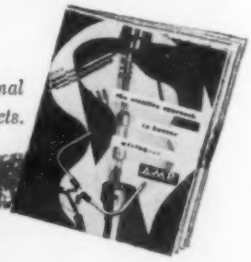

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gear. A hose was fastened to the platform with a nozzle directed toward the ground and fed with air under pressure of 200 psi.

Tests proved that a man could stand on the platform, supported by the jet, with little or no practice. His ability to do it, Zimmerman reported, apparently was related to his confidence and his ability to relax and use instinctive reflexes to operate the device. All he had to do was lean in the direction in which he wanted to go.

Major importance of this discovery may not have been fully evident to the Langley experimenters at that time, but it is fully appreciated today by military helicopter experts.

▶ **Military Possibilities**—Field commanders think it would be a wonderful thing to have every soldier or sailor equipped with a one-man helicopter that would give him full mobility over all kinds of terrain.

One-man helicopters are in being and can be produced at a reasonable cost. Major difficulty is the fact that learning to fly one is a big job and not every soldier can be trained to operate pedals, collective and cyclic controls in addition to a throttle.

Here the flying platform offers a military possibility. So far, not even the researchers call the man flying one of them a pilot. He is, simply, a "flyer."

In the first tests, it was found that the flyer had to avoid any conscious effort at control. The steadiest flights were made when the man on the platform looked into the distance and gave his attention to something else. To the pilot of a conventional helicopter, this is suicidal heresy.

▶ **Balance Problem**—Flyer of the jet platform had a tendency to overcontrol when he looked down and concerned himself with the device's stability. In this respect operation of the flying platform is similar to riding a bicycle, where balance is instinctive but beginners wobble when they watch the ground and consciously try to control the vehicle. Biggest danger on the flying platform is loss of power.

Next step at NACA was construction of a new and larger platform supported by a teetering rotor, 7 ft. in diameter and driven by air jets at the rotor tips. Again, there was a tubular steel frame with a plywood platform, this time equipped with a ring that could be used as a hand rail. The vehicle weighed 140 lb. Two jets of air near the circumference of the device corrected torque created by the rotor blade.

Both indoor and outdoor flights were made up to heights of about 8 ft. and in winds up to 31 mph.

These experiments were carried out in three phases:

- **With a locked rotor** that made the platform resist control.
- **With a free-teetering rotor**, that gave marginal stability and control.
- **With a spring-restrained rotor** that gave satisfactory stability and control.

NACA ALSO FLEW a jet-supported platform, but noise level was objectionable. Rotor-supported vehicle hovers more steadily. Flyer steers by leaning in desired direction.

FLYING PLATFORM developed by Hiller for Office of Naval Research is based on NACA experiments. Machine is supported by ducted fan and two contra-rotating props.

In all tests with both jet thrust and rotor-driven platforms a safety harness was provided to support the flyer in case of power failure or loss of control.

NACA's reports on the experiments were made available to the military services and both de Lackner and Hiller offered proposals incorporating the results and the original Zimmerman patent of 1947.

Other Zimmerman projects at NACA have been concerned with VTO problems and the famous "flying barrel" ducted fan used for basic research in this field (AW Apr. 26, 1954, p. 30).

Lab Expands Work in Human Factors Area

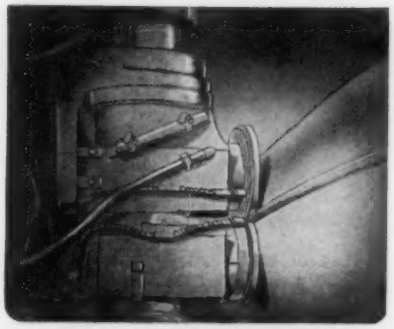
Engineering psychology is being emphasized by the Franklin Institute Laboratories for Research and Development by expansion of the section devoted to that specialized work.

"We are not a testing laboratory in the ordinary sense of the word," says Dr. Henry B. Allen, director of the Franklin Institute. "We deal with more than the routine research problems of personnel selection, time and motion studies, job analyses and product design."

Included in the Institute's Engineering Psychology section are these study areas:

- Equipment design for more efficient human operation.
- Optimizing operating conditions for man-machine systems.
- Determination of human preferences.
- Design and analysis of experiments.

The institute offers a brochure, "Engineering Psychology," explaining its activities in this field.



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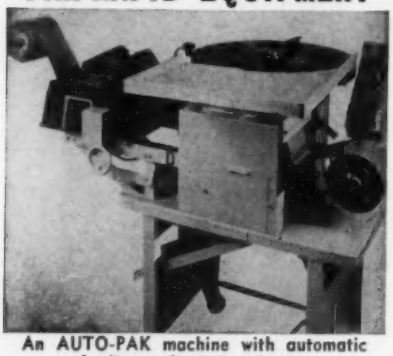

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LETTERS

Scientist Shortage

Read your article entitled, "Scientist Shortage Threatens Defense" in the Mar. 21 AVIATION WEEK (p. 31).

Very well written, but along with the hundreds of similar articles it is making us aware of the problem and very little else. When I say very little else, I ask the question, what is being done and what could be done to deliver new engineers to industry and government?

► **Uphill Struggle**—This I believe is the problem to be yet recognized. The answer, I'm afraid, is a sad one. Compared to Russia's method of producing new engineers, which is one of positive inducement, as against ours, based on voluntary action on the part of our high school graduates, it appears that we have an uphill struggle.

So in order to get more graduates to enter college to obtain an engineering or science degree we have to offer them an attractive inducement. The biggest inducement is economic, like you have mentioned. It is here where you run into a vicious circle. Presently the wage and salaries are high for an engineering graduate. Relieve the shortage and your economic inducement vanishes and also your supply of graduates. Recreate a scarcity and you have the same situation as existing now.

This is not a theory of mine but a painful experience that I had gone through in 1949. Upon graduating in that year with a B. Aero. E. degree, the only positions open were to experienced engineers and a few of the very top caliber of graduates. I can remember one firm wishing to employ an "A" graduate for $40 a week. As much as I hate to write this, it took the Korean conflict to create a shortage and put me to work in the engineering field.

Let us face other facts, our supply of trained engineers and scientists being largely a volunteer stock could possibly fill our needs to come in a few years. This is all based on a defense-civilian economy. If suddenly the defense economy disappeared, you would have engineers and scientists to burn.

► **Shortage Solution**—Getting away from what could happen and considering the problem as it exists today, the problem has created its own solution.

Essentially it is this. Under a democratic type of society we can only encourage high school students to enter the scientific and engineering field. AVIATION WEEK has voiced this loud and clear, so have other publications.

The shortage in industry and government can be wiped out by working your present force to their most efficient capacity with the most generous compensation possible. This responsibility lies with the top brass on the engineering and management totem pole. Sadly enough they find it easier to go out and recruit from other places and find the picking poor at that.

Outside of this, which is based on observation of present and past practices in education and industry, the shortage of engineers and scientists will remain, and a choice topic for discussion at that, also.

MURRAY OGMAN
Design Engineer
3633 Reynard Way
San Diego 1, Calif.

(Aviation Week thanks Reader Ogman for his comments. The article not only stated the problem, but tried to show what is and can be done to solve it. It is sadly true that it took the Korean conflict and the continuing cold war to create the present engineer-scientist shortage, but all indications are that we shall continue to live in an "age of peril" for some time to come. It is also sadly true that salaries for newly graduated engineers were low before the Korean War. This working of the Law of Supply and Demand is true not only of engineer employment, but of every activity in this country.—ED.)

Your Mar. 21 issue includes an interesting article on the concern over shortage of scientific manpower. In addition p. 65 includes a graph showing the plight of faculty members compared to several other working groups, based on a real salary percentages as compared to a 1940 salary index of 100.

It is interesting to note where government engineers fall on this graph, based upon similar data from a Civil Service Commission table, using 1939 as a comparison. The top engineering level of $10,800 is 42.9% and the average engineering level 30% under the buying level of 1939, compared to 5% for faculty members.

It is no wonder that BuAer and other government agencies have lost a good part of their engineering specialists to industry in the past 5 years. The ironical part is that even in industry, engineering as a profession ranks below other professional groups in salary level. Plans to raise the lower grades for government engineers will only result in government agencies acting as paying educational inbetweens from college to industry.

It is almost certain that engineering shortages will exist in the future, if other engineers advise their sons, as I will mine, to stay out of the engineering profession unless they put their desire to be an engineer above that for a high standard of living.

(NAME WITHHELD)
Evaluation Division
Bureau of Aeronautics

Approach Lights

Mr. Modes' letter in your Mar. 21 issue (p. 68) ascribes my attitude on approach lighting to parental pride. It should more properly be ascribed to disgust at seeing the results of careful and laborious test work and study wasted and ignored, and a sound and proven solution to a pressing necessity discarded on frivolous and prejudiced grounds.

If the decision had been made as the

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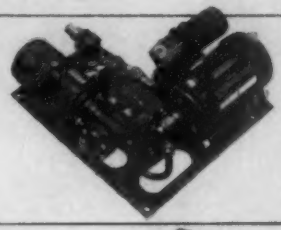

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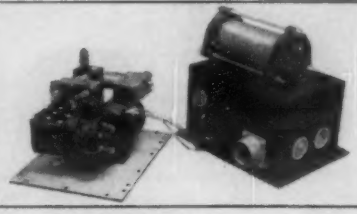
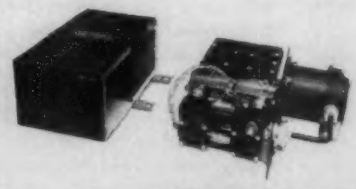
- Operating pressure switch maintains a system pressure of 17 P.S.I.A.
- Motor is 1/25 H.P. 7,500 R.P.M., 27 volts D.C. — T.E.B.B.
- Current draw is 2.0 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 8 lbs. maximum



MODEL E AP-1500 TYPE 203

- Operating pressure switch maintains a system pressure of 30 P.S.I.A.
- Motor is 1/15 H.P. nominal 24-28 volts D.C., 5,000 R.P.M., continuous duty, shunt wound
- Current draw is 3.4 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 12 lbs. maximum



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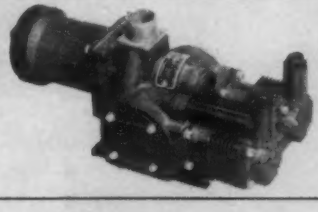
- Current draw is { 1.3 amp./phase / 7.1 on D.C. } amperes maximum under normal operating conditions
- Life is 1,000 operating hours
- Weight is 8-1/2 lb. maximum



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● LETTERS

result of fair comparison under test conditions and honest evaluation of the results, there should be no criticism. A decision based on opinion with no comparative tests, and promulgated by dishonest criticism and misrepresentation, is prejudiced and thoroughly unsound.

▶ **Nearly Unanimous**—A technical committee of 12 representatives of CAA, CAB, USAF, Navy BuAer, ATA, and ALPA, together with alternates and technical assistants, conducted four years of test landings in fog at the Landing Aids Experiment Station. At the end of this testing, the committee recommended that the slopeline approach lights be made standard for the United States. All of the pilots who had participated in the test flying were in agreement with the committee's recommendation. The only dissenting voice was that of the ALPA member.

The ALPA, instead of cooperating, launched a campaign to discredit and ignore the results of the research, and brought all the pressure at its command to discredit the slopeline and to substitute its own preconceived center line pattern.

The pilots who participated in this testing have made, collectively, more low-visibility landings than the entire ALPA membership combined. The participating pilots constitute the most experienced and expert group of fog-landing pilots in existence. Their endorsement of the slopeline approach lights should have more weight than any vague references to the opinions of "10,000 pilots" who have little or no experience in landing in thick fog—and are not allowed to make such landings.

▶ **Pilots Write**—The following quotations are from letters I have received from some of these pilots:

". . . I just read your letter in AVIATION WEEK and I thought you might be interested to know that I still think the slopeline is the best answer yet for the lighting problem. . . ."

". . . I know just how you've felt when you have read all the stupid and biased reports in the past, and no doubt there will be more to come. . . ."

". . . Elevation information on the approach is of paramount importance under all conditions and if only the pilots of today could gain enough instruction and experience on the slopeline to read the information they display then this wrangling would come to a screaming halt. . . ."

These are not influenced by parental pride. They are pilots who have really been through it and who know from experience what they have to have for landings in dense fog and what approach pattern will give it to them.

We were remiss in failing to provide a selling job to the pilots, but the technical committee included an ALPA representative, and we were naive enough to believe that he would welcome positive results and pass them on. I still believe that many of the fraternity will be interested enough to examine the Landing Aids Experiment Station reports and see the truth for themselves.

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How Marquardt Backs Up Ramjet Development Work

By Irving Stone

Van Nuys, Calif.—Although ramjet development is the major activity at Marquardt Aircraft Co., the firm's work in aircraft and missile propulsion also includes afterburners, reverse-thrust devices and high-temperature materials.

Some of the products which have carried Marquardt in 10 years to its present position as a leader in the ramjet field were described in AVIATION WEEK last week (p. 43). The activities and facilities necessary to support this development effort are described in this article.

Accessories

The Accessories Division was activated about two years ago. Chief engineer is R. L. Goodyear. Originally, the division aimed at accessories used in conjunction with ramjet engines, but the work has gone beyond this limitation. The development of accessory drives illustrates this:

• **AD-1,** First accessory drive developed at Marquardt, was for the Grumman Rigel missile. This drive was flight-tested in approximately 10 to 15 Rigel firings. It was a 34,000-rpm. ram-air-driven turbine, hooked to a reduction gear box. It drove a 400-cycle alternator and a hydraulic pump.

Designed to take a 20G launching acceleration, it weighed 53 lb., developed 40 hp. at altitude.

• **This led to the AD-2** air-driven-turbine for use with a 20-in. ramjet built for Air Force evaluation.

The turbine was a direct-drive unit turning an alternator, was designed to operate at temperatures up to 950F. For 35 lb. of weight, 95 hp. was obtained.

• **AD-3,** the third accessory drive development, was for missile service. This unit was supposed to have its air turbine fed by a ground source for launch, then use steam from a hydrogen peroxide generator during the launch before the missile attained sufficient speed for ram air to take over. A complicated throttling and governing device was involved.

The high steam temperatures created a turbine blade problem. Altitude maximum power was 75 hp., weight was 70 lb. Reduction gear box was used to reduce the 30,400-rpm turbine speed.

• **AD-4,** was the next development. This combined the AD-3 gear box and the AD-1 turbine and throttle.

Studied for use as a power source for a guided missile, the unit was designed for a maximum life of 10 hr., was rated at 50 hp. at altitude, weighed 57 lb.

It could be operated on ram air, compressed air, or nitrogen.

▶ **Missile Fuel Pump**—Marquardt found that development of a fuel pump was a necessity for its ramjet work. For present missile service, it developed the air-turbine-driven fuel pump, Model FP3A. Temperature operational limit is 950F. Turbine weight is 11.1 lb., pump weight is 3.9 lb.

Pump is a single-stage centrifugal-flow unit, embodying a novel safety feature. After the missile is exhausted and is on its downleg, the turbine is still driven by ram air. The pump impeller is designed to fail so that it will act as a brake against its own housing, thus preventing the air-driven turbine from running away and disintegrating.

The turbine also may be operated on compressed air or nitrogen.

Rated speed is 27,000 rpm. Rated pump flow is 120 gpm.

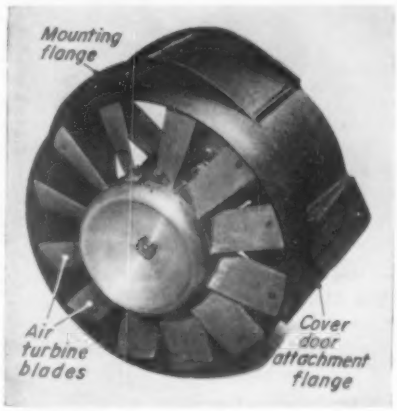
▶ **Emergency Power Packs**—All this led to the present development of emergency ram-air-driven power packages. In this type of unit, a trigger pushes the device out into the breeze and the air turbine starts rotating immediately to drive the accessories.

In one case (Model AD-5A), the unit is flying in an interceptor in which it drives a hydraulic pump to supply power for the flight control.

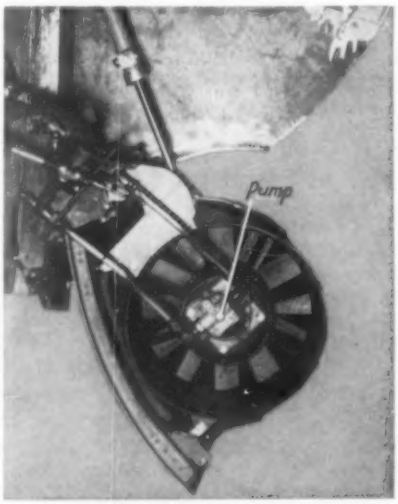
In another application (Model AD-6A), the ram-air-driven accessory turns a pump for hydraulic services and an a.c.-d.c. generator for electrical services. This unit is now ready to fly in a Navy fighter.

On another version of the AD-6 air turbine accessory, Marquardt is attaining production status in connection with a fighter plane.

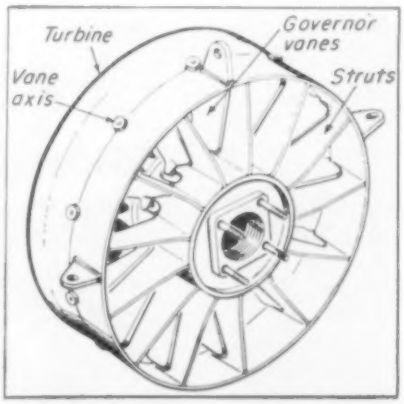
Speed of the AD-6A unit is controlled by a set of governor vanes mounted behind the turbine wheel. The flyball



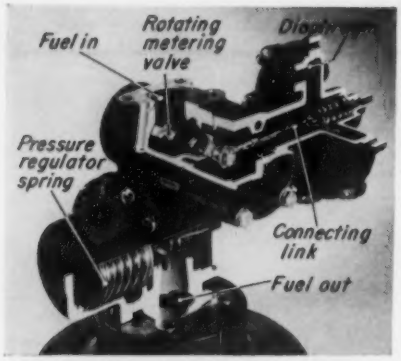
MODEL AD-5 emergency power pack consists of ram-air-driven turbine that drives pump to supply power for flight controls.



REAR VIEW of AD-5A shows pump. Trigger pushes device into air stream when craft's accessories require emergency power.



ANOTHER emergency power pack. Rear view shows governor vanes which choke air to turbine, and thus regulate turbine speed.



FUEL REGULATOR developed by Marquardt for ramjet-powered missile. The regulator is only a part of the ramjet control system.

governor closes the vanes to choke the air and so regulate the air turbine speed.

▶ **Bleed & Bleed-Ram**—Marquardt also is investigating a bleed air turbine for accessory power, in subsonic and transonic piloted turbojet aircraft applications.

Another study is concerned with a bleed-ram turbine for supersonic applications. This would use bleed air for relatively low speed conditions, then switch to complete ram for high speed. This would minimize thrust loss entailed with bleeding air from a compressor as Mach number increases. The penalty for using bleed air at M 1.5 is about twice that at M 0.8.

▶ **Ramjet Fuel Control**—Important function of Marquardt's Accessory Division has been to develop fuel controls for the company's ramjets.

Marquardt's engineers say that because of insufficient interest in the industry to develop these controls, the company got into the picture itself.

Two factors make the ramjet control unique, Marquardt engineers say. These are flow rates up to as much as 180 gpm., and a flow range of about 30 to 1 (from 6 to 180 gpm.).

Marquardt has developed about 14 different basic models of ramjet controls thus far, operating on hydraulic and/or pneumatic principles. Some of these units are servo-actuated, some direct-actuated. Diaphragm or bellows motors are used for sensing units.

No electronics were desired for the environmental conditions involved; and in some cases, there was no electrical power available, so Marquardt turned to pneumatics and hydraulics. Also, this philosophy was in keeping with Marquardt's principle of keeping the ramjet self-sufficient.

Various models of the fuel controls have been or are being used on missiles. Basically, the units control these functions: maximum thrust, minimum thrust, modulated thrust for vehicle speed control, and blowout protection. These functions are automatically maintained.

This work in hydraulic-pneumatic fuel controls has led Marquardt to apply its know-how to the development of turbojet controls. One of these is now flying in a military aircraft.

▶ **For New Fuels**—Ramjet development also will require the perfection of controls for fuels other than gasoline and major hydrocarbons. This advanced design work is the next area Marquardt will move into.

While the company will make no comment, it is logical to believe that since Olin-Mathieson Chemical Corp. is the holder of a substantial minority interest in Marquardt, that the two organizations will collaborate closely on the development of fuels for future ramjet engines.

Marquardt Ramjet Chronology

Backbone of Marquardt's work is the ramjet powerplant, for various applications in subsonic and supersonic service. Here is a brief history of company's ramjet developments:

• **C20-.85A SUBSONIC 20-IN. RAMJET** is the development ancestor of this work. Marquardt delivered it for flight test in December 1945. A later version with higher thrust, the C20-.85C powered the Martin-Navy KUM-1 Gorgon IV flying test bed. By 1947, various models of this C20-.85 ramjet had been flight tested on the F-51, XP-83, F7F, and F-82.

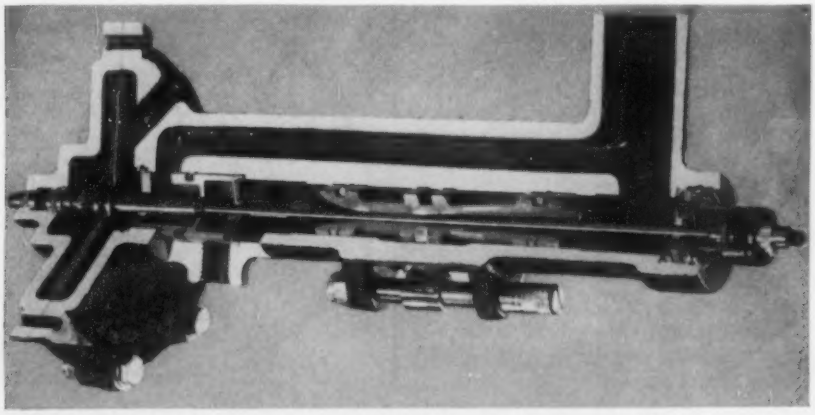
Another model, C20-.85D, demonstrating more thrust and improved reliability, was tested by Lockheed in a specially modified F-80 at altitudes up to 36,000 ft. Redesigned for production, this ramjet was designated the C20-.85F. plane. Now known as the MA 15F subsonic ramjet, the engine is designed to operate in a Mach 0.3-0.85 speed range, at altitudes up to 20,000 ft.

• **OTHER MARQUARDT RAMJETS** include the C30-1.0B, a 30-in.-dia. unit designed to fly at speeds up to Mach 1; the C48-.85B, a 48-in. ramjet designed as an expendable auxiliary-thrust unit for interceptor aircraft; a 6.6-in. ramjet for powering the rotor of the Marquardt M-14 copter; and a 26-in. subsonic ramjet, with scoop-type diffuser inlet, designed as an integral type powerplant for the fuselage of pilotless aircraft.

Later, under a BuAer contract, a development program was undertaken to improve the basic 20-in. engine's high-altitude performance and provide an altitude-compensated thrust control, which could be set for various cruising speeds while in flight. This work resulted in the model C20-.85G, delivered to the Navy in 1953.

• **FROM THIS EXTENSIVE BACKGROUND** stems the supersonic ramjets which Marquardt has already developed and is working on for future applications.

One of the company's supersonic ramjets is powering Boeing's Bomarc missile (AW Mar. 21, p. 17).



THE MACH SENSOR PROVIDES INTELLIGENCE to the diaphragm of the fuel regulator. This results in constant thrust to hold the flight Mach number steady.

Test Facilities

Several different types of Marquardt development ramjets are under test now in the company's jet laboratory, a USAF facility, which also includes special test facilities of the Navy. The lab covers approximately 8 acres and cost about $3 million. Chief engineer of the Test

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Mounting Flange: Gyro axes referenced to mounting holes and mounting plane within 0.25°.

Vibration: Along any principal axis—sinusoidal motion:

12g 100-200 c.p.s.
6g 20-100 c.p.s.
6g 200-500 c.p.s.

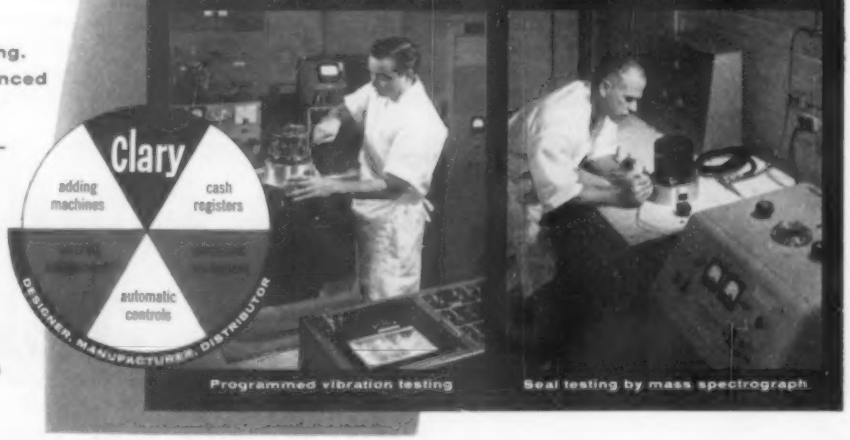
Pickoffs: 3 Wire synchro, each axis:

Null voltage: 50 mv or less
Input voltage: 26 V., 400 c.p.s., single phase.

Motor: Supply Voltage: 115 V., 400 c.p.s., three phase.

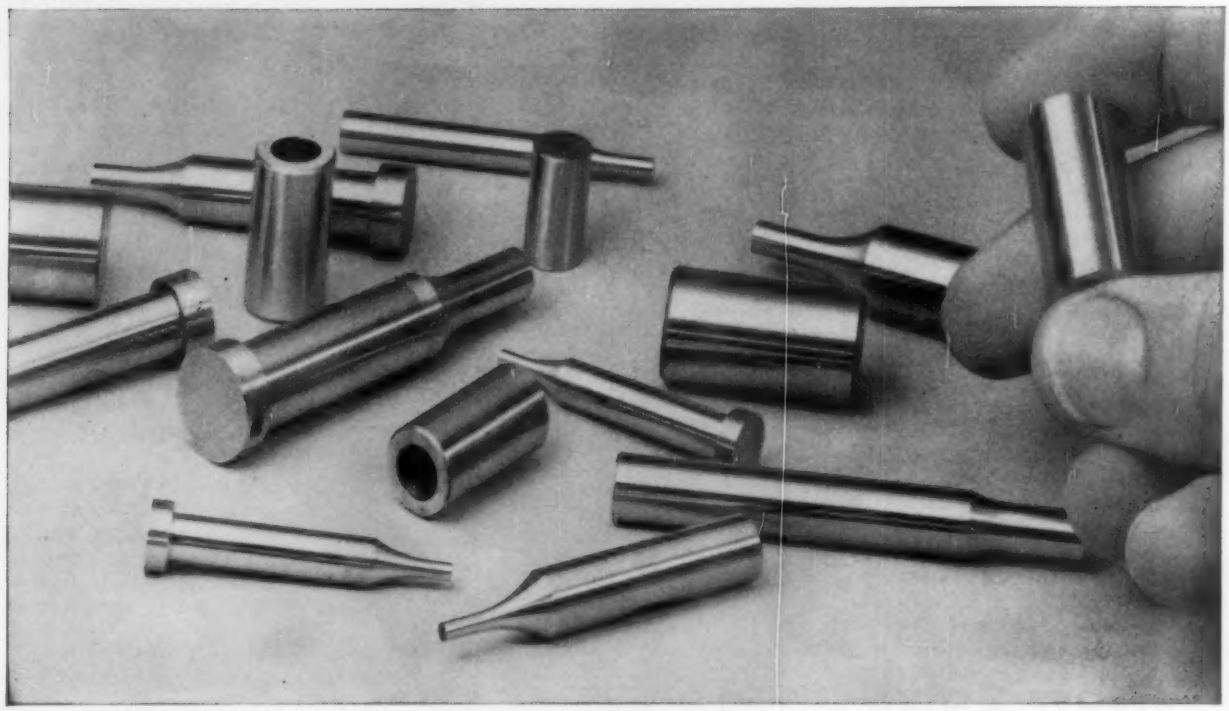
Determination of spin-axis alignment

Dynamic drift measurement



Programmed vibration testing

Seal testing by mass spectrograph



How the country's largest exclusive producer of punches and dies changed complaints to contracts

. . . with Graph-Mo® steel

PORTER Precision Products, Cincinnati, Ohio, is the country's largest exclusive manufacturer of punches and dies—37,000 different sizes in stock. Formerly, Porter produced these products from water-hardening and other high-carbon tool steels, but found that such steels presented distinct disadvantages. For example, they distorted in heat treating, were relatively expensive and difficult to machine, and did not meet customers' demands for longer life.

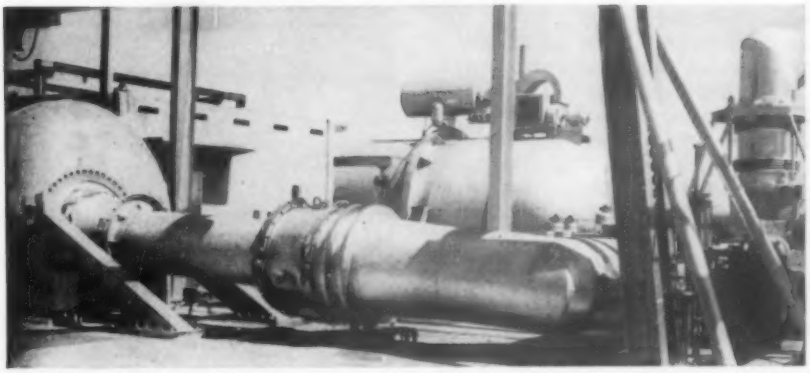
With a view to correcting these problems, Porter engineers adopted Graph-Mo®—one of four graphitic tool steels developed by the Timken Company—as a standard for the manufacture of punches and die buttons. Because it contains free graphite, Graph-Mo is easier to machine. And punches and dies made of Graph-Mo don't scuff or gall. From every aspect, Porter's adoption of Graph-Mo steel has proved eminently successful.

Graph-Mo outwears ordinary tool steels on an average of three to one. Millions of tiny particles of diamond-hard carbide—one of the most wear-resistant substances known—give Graph-Mo steel longer service life.

Graph-Mo may be the solution to *your* punch and die problems. For more information about all four graphitic steels developed by the Timken Company, and their uses in dies, punches, gages, and machine parts, write for the new Timken Graphitic Steel Data Book. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



ANGLE-OF-ATTACK TESTING is carried on in free jet facility. Angle of airstream entering cell (left) may be varied by means of movable inlet pipe (shown in foreground).

BATTERY OF AIR BOTTLES at Marquardt Jet Laboratory provides motive power for blowdowns. Cooling tower is seen at rear.

Division is Leigh Dunn.

Testing now is concerned almost entirely with supersonic ramjet flights at altitudes far above the capabilities of piloted aircraft. This, of course, means simulating a missile environment.

▶ **Labs at Capacity**—Not only is Marquardt now utilizing its test facilities at full capacity, but its current requirements are well above the installation's capabilities—more air is needed at the present altitude levels.

This situation will become more critical with free stream requirements for engines which will be in the picture soon. They could not be tested to full operating range with the present test setup. This conditions generally applies to all private ramjet developments in the U. S.

NACA facilities are also limited. Here, time is the bind, because they must be shared with other contractors.

Arnold Engineering Development Center (AEDC) also is limited at the present time. Eventually it will be able to take care of any currently projected type of engine, but so far as giving all contractors sufficient time, there is a bind to be expected here too, Marquardt engineers say.

▶ **Quick Use**—In the Jet Lab, air must now be pumped for 2½ hr. to fill the air bottles for 40,000 cu. ft. of storage at 250 psi. This volume is expended in less than 1 min. To have a compressor plant to do the same job "steady-state" would require an installation of about 180,000 hp. A compressor installation costs about $150/hp., indicating a total price in the millions.

Present operating time of the blowdown is sufficient to give valid test results. Plans calling for a decrease in pump-up time to about ½ hr. are underway. This would allow more frequent test runs. Intentions also are to increase the exhauster capacity by 100% to boost mass flow under altitude conditions.

For low-altitude operation, blowdown air only is used. At intermediate altitudes (20,000-60,000 ft.), blowdown and exhauster are used. Above 60,000 ft., only the exhauster facilities are employed.

Marquardt's Jet Laboratory includes these units:

• **Sea level test.** This cell is used primarily for testing ramjets under sea level conditions. Hot gas from the ramjet exhaust is ducted through a cooling water spray and a silencer before being exhausted vertically. Air and fuel flows, pressures, temperatures, stress, strain and thrust are recorded automatically on oscillograph tape, charts and photographic films, for final analysis with highspeed computers.

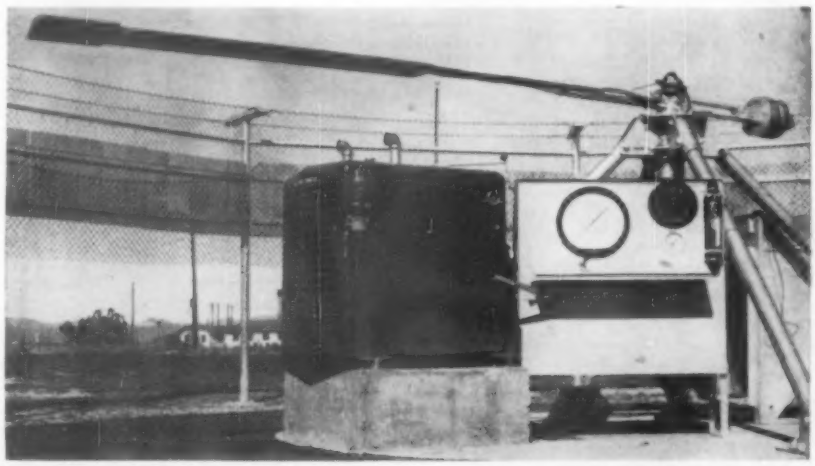
High-pressure air is supplied to the test engine through subsonic, sonic or supersonic nozzles. These are interchangeable for creating desired air speeds.

• **Altitude test chamber.** Air for simulated high-altitude flight is rarefied in this chamber with an exhauster system which uses gases from two turbojets to drive the gas turbines of several other turbojets. Compressors of the driven engines have about 12,000 hp. to exhaust extremely large quantities of air through the ramjet engine and from the test chamber.

• **Free-jet test.** This cell has a provision for varying the direction or angle of the airstream entering the facility. A movable inlet pipe provides a means for angle-of-attack testing similar to conditions encountered during flight. A silencer on rails can be moved to cover or expose the entire engine test setup. Instrumentation in the altitude test chamber is used to measure and record the data for tests conducted in the free-jet facility.

• **Component test.** This temporary facility is used for special studies of ignition and combustion problems and rapid evaluation of engine component parts. It also can be used for high-altitude tests: an air ejector creates a partial vacuum in the aft portion of the cell.

• **Model-scale sea level test.** This cell is a free-jet facility for testing small-scale ramjets and engine parts. Air moving through a special nozzle increases or decreases proportionately in



'TWO-DIMENSIONAL' ramjet is mounted on the rotor arm at the whirljet test facility.

speed when the nozzle opening is decreased or enlarged. To do this, one wall of the cell's air nozzle is movable, providing a continuous wide range of supersonic flow speeds, simulating actual flight conditions.

Model mounting base is also movable to permit angle-of-attack testing. A shadowgraph camera photographs shock waves around and through model.

• **Accessory drive facility.** High-altitude operation is simulated in this installation by evacuating the air storage tanks and drawing air through the test unit from the outside atmosphere. A turbojet burner is installed in the inlet piping to provide air heating.

• **Fuel metering facility.** This is used for development testing and evaluation of automatic control and fuel systems before they are installed in ramjet and turbojet engines. Included in the installation are high-pressure, high-flow fuel supply systems, high-pressure air systems, vacuum systems, and a hydraulic system for operating various fuel controls. The facility also includes an environmental chamber, supplied with heated air for testing fuel system components.

• **Afterburner test cell.** Afterburners are attached to turbojets for testing in a static test facility sponsored by the Navy. Noise is minimized by silencers on the air intake and exhaust. Exhaust gases are cooled by water spray. Instrumentation records the pressures, temperatures, fuel and air flow, thrust, vibration and other factors related to turbojet and afterburner operation.

MARQUARDT PLANT—Engineering building is in foreground, main plant in center, and test facility in the rear.

• **Whirljet facility.** This installation was designed for testing ramjet drives developed to power helicopter rotors. A 150-hp. gasoline engine powers a counterbalanced rotor arm, with the ramjet mounted on the arm tip. The engine supplies enough power to whirl the rotor arm until it reaches speed where the ramjet will ignite and operate. Fuel and instrumentation lines in the arm are connected to the test engine on the rotor tip.

Long-Range Planning

Long-Range Planning and Research Division performs two functions.

• **Planning**—anticipating product trends in areas where the company now operates or might enter. This planning is done in a staff capacity, and results end up as recommendations.

• **Support** of other Marquardt divisions, by introducing product improvements which offer promise for the future. These improvements generally involve proving on a small scale to establish that the idea is feasible. This research function also may be concerned with areas which do not fit into present Marquardt projects.

Long-Range Planning and Research is a new division at Marquardt—started in November 1954. Headed by chief engineer John Drake, its personnel now numbers about 25 engineers.

One of its first studies, logically, is concerned with areas where the ramjet can now be used or where it might be used in the foreseeable future. Already some new powerplant cycles have been studied. Some are variations of cycles now in existence, others are radically different.

The division also has probed new fuels, new types of diffusers, accessory systems, and controls. It is looking at possible commercial application of the company's military products.

The division also offers staff advice to company officials on whether the organization should or should not respond to invitations to bid.

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The spacing of two Oilite bronze radial bearings creates a small "oil well" where Zephyr bearings ride with cool efficiency in their oil bath.

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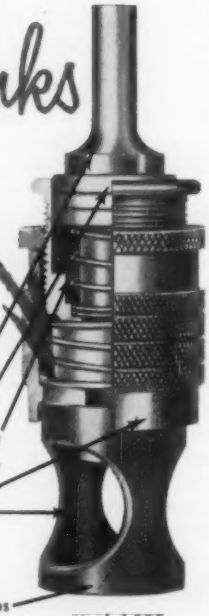

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actual size

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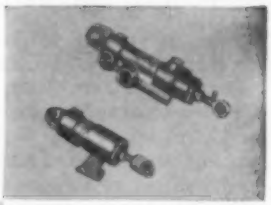
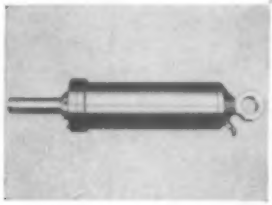


Gun Purge Door Cylinder – 3000 psi, 3/4" bore x 2-1/2" stroke

Door Latch Cylinder – 3000 psi, 1-1/16" bore x 1" stroke

Armament Displacing Cylinder 1500 psi air cylinder 2" bore x 8-1/4" stroke



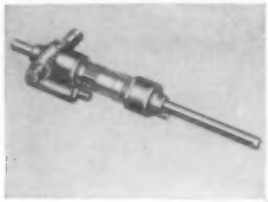
M.L.G. Actuating Cylinder – 3000 psi, 6" bore x 17-1/2" stroke

When a manufacturer gains the reputation of being a primary source for any product, it is usually indicative that they have the "know how" and facilities to produce at competitive prices.

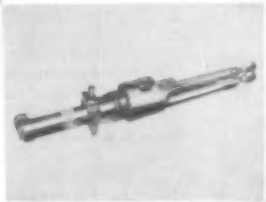
The ability to produce the smallest to the largest, the simplest to the most complex cylinders has made Loud top source for high quality – low priced units.

In addition to making the ordinary actuating cylinder, Loud produces units containing integral mechanical locking devices, snubbing cylinders, power control booster cylinders, as well as a patented mechanically locking cylinder adaptable to many applications where the load is required to be firmly held without pressure and yet easily unlatched and moved hydraulically or pneumatically.

Aileron Booster Cylinder – 1500 psi, 1-9/16" bore x 6-1/8" stroke

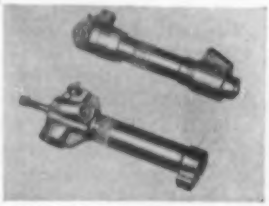


Powerplant Door Cylinder – 1000 psi air cylinder 1-1/4" bore x 8-1/2" stroke w/mech. locks at both ends of stroke



Nose Gear Door Cylinder – 3000 psi, 1-3/16" bore x 7" stroke

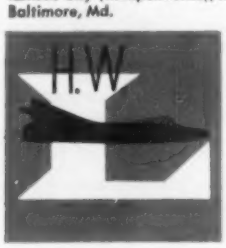
Nose Wheel Steering Cylinder – 3000 psi, 1-1/4" bore x 6-3/4" stroke



Engineering and design development by
Haskel Engineering Associates
Glendale, California

National Sales and Service by
Haskel-Loud Aircraft Service Corp.
Glendale, California

Resident Sales Engineers located in
Seattle, Wash.
Kansas City (Independence), Mo.
Baltimore, Md.



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Empty promises are strictly for the birds. Here's the true story of what an engineer's future *can* be.

Fairchild Engine Division's new plant and Advanced Engine Test Laboratory at Deer Park, L. I., are the most modern, newest and best equipped facilities in America today for the development of propulsion systems for target drones, guided missiles and piloted aircraft utilizing new fuels and principles of propulsion.

In other words Fairchild is a good place for the right man to feather his nest—where he can be sure of stimulating work and the chance to see his own ideas realized and rewarded. Right now, Fairchild wants:

Design engineers
Project engineers
Installation engineers
Aerodynamists
Thermodynamists
Stress analysts

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USAF Contracts

Following is a list of recent USAF contracts announced by Air Materiel Command.

Bendix Radio Div., Bendix Aviation Corp., Towson, Md., radar sets, 100 ea., $801,040; power supplies, 25 ea., $620,443.

Electro-Voice, Inc., Cecil & Carrol, Buchanan, Mich., microphones, dynamic, 20,369 ea., $208,782.

General Riveters, Inc., 785 Hertel Ave., Buffalo, N. Y., modulators, radio, 27 ea., cabinets, 28 ea., amplifiers, 27 ea., $121,094.

Grant Photo Products, 18915 Detroit Ave., Lakewood, Ohio, paper, 8,916 pkg., 2,000 rolls, $175,215.

Haloid Co., 2-20 Haloid St., Rochester, paper, 15,590 rolls, $114,326.

International Telephone & Telegraph, 500 Washington Ave., Nutley 10, N. J., bar assemblies, 203 ea., coils, 191 ea., covers, antenna, 204 ea., $49,761.

Mercury Trading Corp., 157 E. McMicken Ave., Cincinnati, headsets, microphones, 4,000 ea., $43,800.

Multi Electric Mfg., Inc., 4223 West Lake St., Chicago 24, approach lights, 2,640 ea., $25,924.

Avien, Inc., 58-15 Northern Boulevard, Woodside 77, N. Y., base, indicators, transmitters, bridge-totalizer and amplifier, 261 ea., $148,978.

Piasecki Helicopter Corp., Morton, Pa., services for repair and modification of H-21 wooden rotor blades, 228 ea., $470,400.

Union Carbide & Carbon Corp., Linde Air Products Co. Div., 30 E. 42nd St., New York 17, oxygen, liquid propellant, 40,000,000 cu. ft., $2,000,000; nitrogen gas, water-pumped, 72,300,000 cu. ft., $361,500; nitrogen liquid, 15,000,000 cu. ft., $75,000; oxygen gas, 5,000,000 cu. ft., $25,000.

Goodyear Tire & Rubber Co., Inc., Akron 16, wheel assys., 191 ea., brake assys., 192 ea., 224 ea., $318,020; facilities for the production of B-61 components, $480,000.

Hoover Electric Co., Los Angeles, actuator assys., electro-mechanical, 148 ea.; actuator assys., electromechanical, 271 ea., $86,046.

Houston Fearless Color Corp. of America, West Los Angeles 64, selective processing machines, 6 ea., $176,000.

Jack & Heintz, Inc., Cleveland, generators, 1,597 ea., $41,442; a.c. generators, voltage regulators, control panels, spare parts and data, $757,626; motor assys., 293 ea., $127,361.

Kelsey-Hayes Wheel Co., Detroit, acquisition and installation of additional facilities for the production of compressor spacer sets, $631,400.

Kollsman Instrument Corp., Elmhurst, N. Y., indicators, $1,915,822.

Lear, Inc., Lear-Romec Div., Elyria, Ohio, components of pressurizing set, $185,596.

Lundy Manufacturing Corp., Long Island City, N. Y., power units, 115 ea., shafts, 207 ea., 91 ea., $47,214.

Morse Instruments Co., Hudson, Ohio, test equipment for printer-projector, $103,052.

Saco-Lowell Shops, Boston, Mass., shackles, bomb, 10,730 ea., $99,574.

Sperry Corp., Sperry Gyroscope Co. Div., Great Neck, L. I., N. Y., training parts to be selected and furnished, $100,000; indicators, 650 ea., $560,138.

United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn., propeller assys., 5 ea., control & brush pads, 5 ea., $57,860.

Westinghouse Electric Corp., Dayton, window temperature control assys., $44,500.

Weston Electrical Instrument Corp., Newark, N. J., indicators, $202,646.

Wm. R. Whittaker Co., Ltd., Los Angeles 38, actuators, $217,997.

Edward Blake Co., West Newton 65, Mass., grinding machines, drill, bench type; ½-in. drill capacity; motor; 100 ea., $28,110.

Enterprise Co., Columbiana, Ohio, surfacer, single cylinder, 36" x 8" wedge-type bed, complete with knife jointer, knife grinder, knife-setting jig and one extra set of cylinder knives, 15-hp. motors, 45 ea., $222,750.

Balcrank, Inc., Cincinnati 9, Ohio, reel,

Super flying comfort on

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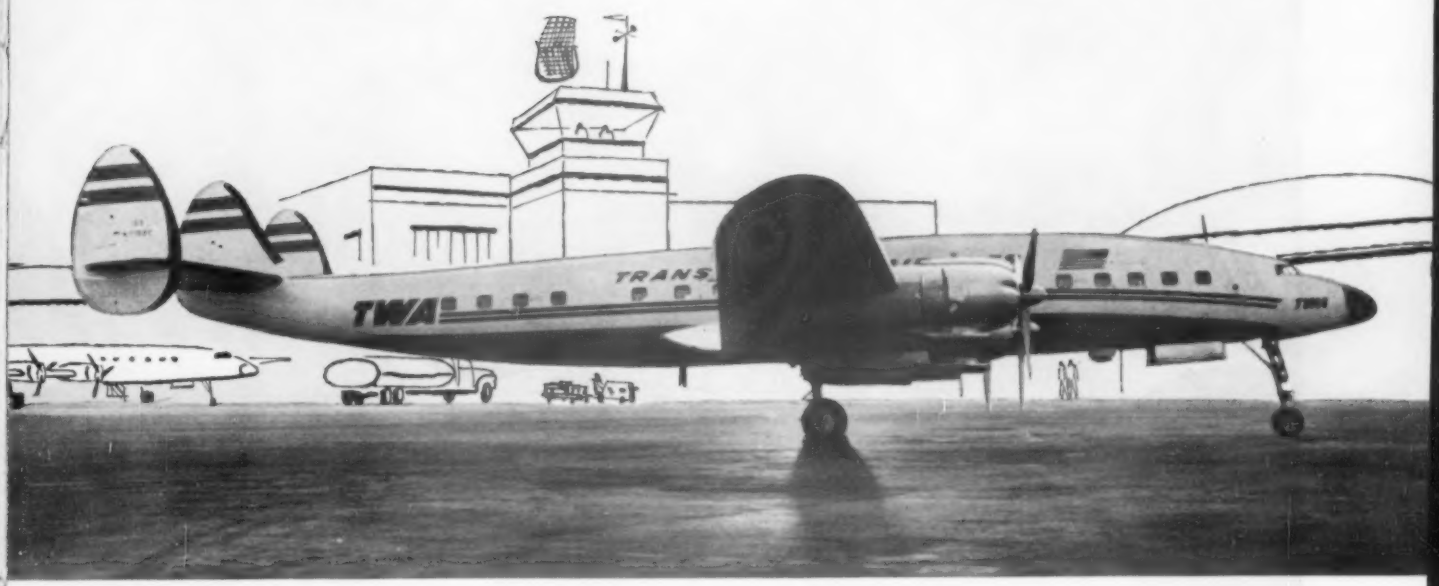
includes the smoother flying qualities of

Bendix PB-10A AUTO PILOTS



Trans World Airlines' new Super-G Connies are dedicated to the most luxurious kind of passenger comfort. So it is not surprising that the auto pilots chosen for these deluxe ships are Bendix PB-10A's.

As they have proved on most of today's great airliners, these Bendix Auto Pilots assure the smooth, dependable operation that means maximum passenger enjoyment, comfort and safety.

TWA's new Super-G Constellations are also equipped with a Bendix Flux Gate* Compass System plus an imposing array of other flight, engine and navigation instruments made by Eclipse-Pioneer—foremost name in aviation instruments and components.

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To physicists and engineers with broad analytical ability

An address by R. P. Buschmann, Department Manager of Company Studies, on "Planning for the Best Airplanes" is available to interested scientists. It shows the approach Operations Research takes to various problems. Address inquiries to Mr. Buschmann.

Operations Research experience is not necessary to join the department. A high degree of scientific ability and proven analytical traits are primary requirements. Those interested are invited to write E. W. Des Lauriers, Dept. O-3-4.

Operations Research at Lockheed is a unique division which projects studies covering the entire spectrum of airborne systems five to twenty years into the future.

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hose air with hose and inflator gage, 342 ea.; reel, water hose, complete with service hose and connecting hose, 568 ea.; reel, low pressure, hose, for oil, complete with service hose and connecting hose, 453 ea.; reel, hose low pressure, for gear lubricant, complete with service hose and connecting hose, 346 ea., reel, hose high pressure, complete with service hose, and connecting hose, 554 ea., $83,764.

Gallmeyer and Livingston Company, Grand Rapids 2, Mich., grinder, surface hydraulic horizontal reciprocating table, 12 x 36-in. working surface; complete with dust collecting unit and one (1) each A36J7V grinding wheel, 36 ea., $383,904.

General Electric Co., Johnson City, N. Y., kit, modification relocation of turret safe switch A5 fire control system, 639 ea.; kit, modification of tail structure, 30 ea.; kit, modification of cable assy. auxiliary junction box to free firing box, 84 ea.; kit, modification of auxiliary junction box, 85 ea., $49,586.

Newman Machine Co. Inc., Greensboro, N. C., tenoner, single end, direct motor driven, 55 ea., $123,695.

Triangle Refineries Inc., Houston 5, Texas gasoline, automotive motor fuel M. 74 oct. 200,000 gal., $27,620.

Navy Contracts

Contracts recently announced by the Navy's Aviation Supply Office, 700 Robbins Ave., Philadelphia 11, are:

American Chain & Cable Co., Inc., American Cable Div., 271 S. Pennsylvania Ave., Wilkes-Barre, launching pendant assemblies, steel, F9F airplane, 170 ea., 2,870 ea.; launching pendant assemblies, steel, FJ-2, FJ-3 airplanes, 50 ea., 540 ea.; launching pendant assemblies, steel, S2F-1 and -2 airplanes, 20 ea., 155 ea., $121,905.

Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, milling machine, horizontal, 1 ea., $29,295.

AiResearch Mfg. Co., 9851-9951 Sepulveda Blvd., Los Angeles, kits, retrofit, 471 ea., $252,503.

Allied Paint Mfg. Co., Inc., E. Thompson & Luzerne Sts., Philadelphia, resin, 20,000 gal., $35,200.

American Pipe & Steel Corp., 2201 W. Commonwealth Ave., Alhambra, Calif., buoys, $52,659.

Bendix Products Div., Bendix Aviation Corp., 401 Bendix Drive, South Bend 20, Ind., parts for JPA5, JPC2 pumps, $987,806.

Chicago Aerial Ind., Inc., 1980 N. Hawthorne Ave., Melrose Park, Ill., photo observer assy., power unit assy., dehydrator assy., $41,314.

Custom Electronics Corp., 738 Speedwell Ave., Morris Plains, N. J., test sets, 108 ea., $56,117.

Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, parts for R6D-1 aircraft, $34,932.

Hub Paint & Varnish Co., Inc., 47-38 Fifth St., Long Island City 1, enamel, $28,200.

Lear, Inc., 110 Ionia Ave. N.W., Grand Rapids 2, Mich., actuators, 129 ea., $37,373.

Scintilla Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y., dynamotors, 100 ea., $41,811.

Hub Paint & Varnish Co., Inc., 47-38 Fifth St., Long Island City 1, N. Y., enamel, 27,-100 gal., $52,175.

Rhodes Lewis Co., 6151 W. 98th St., Los Angeles 45, parts, box assy., for Grumman aircraft, 169 ea., $39,737.

Utica Div., Bendix Aviation Corp., Utica, N. Y., pump assys., air, 473 ea., $182,559; pump assys., $281,345.

AiResearch Mfg. Co., 9851-9951 Sepulveda Blvd., Los Angeles 45, exchangers, 143 ea., $49,478.

B. F. Goodrich Co., 500 S. Main St., Akron 18, wheel assys., 510 ea., $38,372.

D. L. Auld Co., 5th Ave. and 5 St., Columbus 1, Ohio, reels, $81,741.

General Laboratory Associates, Inc., 17 E. Railroad St., Norwich, N. Y., ignition units, $224,489.

Glidden Co., Chemicals, Pigments, Metals Div., 1717 Summer St., Hammond, Ind., pigment, 216,000 lb., $88,560.

(Advertisement)

Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Miles,
Senior Member, Aviation Writers Assn.

The "promise anything" outfits are still with us—unfortunately.

Since we last discussed these technical innocents more than two years ago, some have learned the error of their ways. Some have succumbed to their own ineptitude. Others hang on to plague the industry with big talk and little performance. And here and there new opportunists have entered the field.

These are the second-source bravos with trial-and-error methods and a particular knack for fouling up everyone, including themselves. About the only thing you can say for them is that they're long on promises and short on capability.

I'm not talking about veteran suppliers who know their business from long years in the game or about the up-and-coming young firms that build solidly on experience with good sense and good judgment. Such companies don't over-reach themselves in a frantic gamble for orders.

It's the unqualified second source with the glib line, the fancy drawings and the cut-rate price that invariably pitches a wrench into the machinery and has to be "bailed out."

Such fumblers know they haven't the skill or the experience to turn out quality and quantity on a par with veteran suppliers, yet they'll dive in over their heads on the long chance, apparently operating with the mutual motto: "Get the order first and worry about it later."

Trouble is, they inevitably snarl others into a tangle of problems, too—the military service that can't get the airplanes it needs because an inefficient second source has flubbed a job of supply; the prime manufacturer who can't complete the ships for delivery, and the veteran supplier who must reschedule his entire production for a rush job to straighten out the mess.

Sure, such a deal looks wonderful on paper. Why can't "Eager, Inc.," turn out units that will be just as good as those of the original source? Here's the bid and here's the promise. And look at the price!

Then comes the deluge of grief, opening with revised promises from Eager, Inc., and followed by delays and more delays. Next in the ill-fated sequence comes the first production item, of poor quality and entirely unsatisfactory. Then more stalling while the scrambling hopeful attempts to recoup. Perhaps a few more production units show up, little better than the first. Finally, failure, and the dismal recognition that only experience pays off.

By this time, airframe deliveries are far behind schedule. The military is demanding production and the distraught prime manufacturer is scurrying back to the original supplier for emergency help.

But a rush order that must be shoehorned into smoothly-functioning production processes almost always brings a cost boost over the normal price of a technical item to meet the exigencies of disrupted production and increased expenses. Hence the unit cost, in most cases, is more than it would have been had the major manufacturer ordered from the original supplier in the first place. This plus the delays and worries already suffered!

Veteran suppliers in every technical field know this routine well. In fact, they can almost judge the percentage of their annual business that will call for "bailing out" inadequate firms that find their over-anxious promises snagged on the intricacies of engineering skill and production experience.

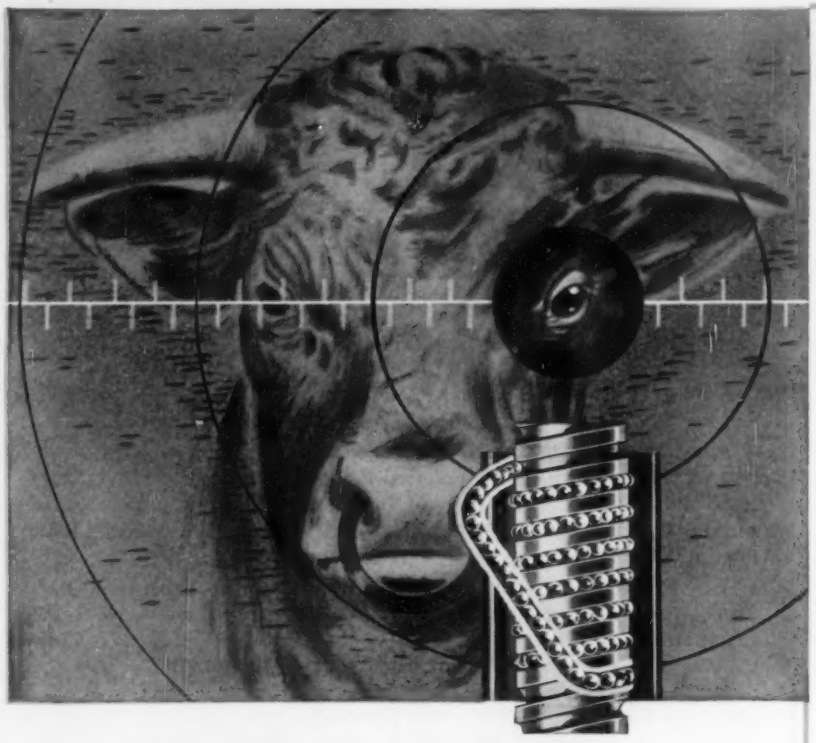
All recognized firms in the field of aircraft supply are constantly battling competition and they'll acknowledge that adept rivalry is a healthy situation, giving more and better production for the taxpayer dollar. For this reason you'll not find top-rank suppliers complaining when a second source is named from among their ranks.

Nor do I imply that licensed second sources are in any way the cause of chaos wrought by paper promises. Such concerns have full technical help from the original supplier and in many cases tooling, too. Their ability to produce is solidly backed by the experience of the licensing firm.

You certainly can't blame any company—veteran or youngster—for going after business and doing its best to catch a share of orders in any given field. But in a technical field such as aviation, where national security is involved, additional criteria must apply.

No supplier has the right, for the sake of a fast buck, to take on a job he has no chance of completing. Yet these try-babies are still in there pitching. Their fade-out is in sight, however. The industry is wising up—fast.

EQUIPMENT



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New Jets Get Ratio Thrust Indicators

By George L. Christian

Measurement of tailpipe temperature and rotor rpm. is no longer a sufficiently accurate method of determining jet powerplant thrust. With new, twin-spool turbojets, where one compressor may be operating near stall condition without the pilot being aware of it, need for precise indication of thrust is especially necessary.

To meet this need, the ratio between total tailpipe exhaust pressure and total engine inlet pressure can be used. A number of pressure ratio indicators is now in production.

• **Kollsman Instrument Corp.**, Elmhurst, N. Y., is producing a unit for USAF's supersonic McDonnell F-101A Voodoo fighter.

• **AiResearch Div.** of the Garrett Corp., Los Angeles, is making an indicator for Air Force's jet heavyweight, the Boeing B-52.

• **Minneapolis-Honeywell** is also making a pressure ratio indicator for the B-52 (AW Oct. 4, 1954, p. 60).

Kollsman is supplying other pressure ratio indicators to the National Advisory Committee for Aeronautics, General Electric, Curtiss-Wright and Convair.

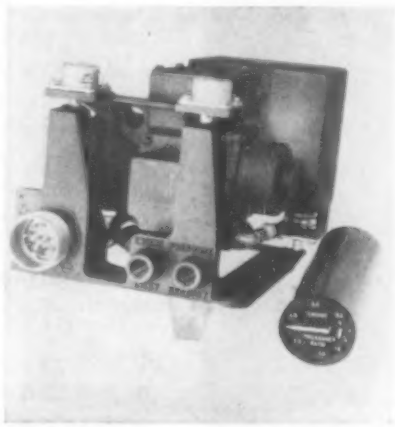
▶ **Why the Need?**—Kollsman points out that, since the twin-spool jet has two major rotating components, engine efficiency can vary over a wide range without any appreciable rpm. change.

AiResearch says that very small variations in rpm. and temperature indication can result in large thrust variations —therefore new engine power instrumentation became necessary.

▶ **What It Does**—The instrument measures total exhaust tailpipe pressure and total engine inlet pressure and tells the pilot the ratio between the two pressures.

The pilot, knowing what the pressure ratio values should be, can immediately determine whether his engine or engines are putting out the required power (as soon as he corrects the instrument for ambient temperature), Kollsman says. Also a manually adjustable temperature index can be provided to show the proper pressure ratio corrected for altitude.

With this instrument, the pilot can accurately check power output of the engine during any portion of its operating period—run-up, takeoff, climb or cruise. And as soon as the plane becomes airborne, the instrument allows pilot to select the engine's optimum power setting for most economical fuel consumption, thus simplifying cruise control problems, Kollsman claims.



AIRESEARCH pressure ratio indicator.

AiResearch points out that the instrument is particularly applicable to multi-jet bombers and transports, where long range is of prime importance. Previous power setting techniques gave only approximate results, the company says.

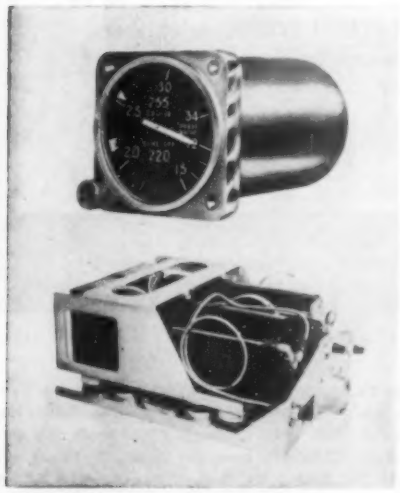
Operation of the instrument is simple for the pilot. He merely selects a power regime which makes the instrument read a predetermined optimum power setting. Two diaphragms in the instrument measure the tailpipe and inlet air pressures respectively. Through a lever system and gear train the diaphragm's movement is converted to pointer rotation.

▶ **Two Systems**—The Kollsman instrument is available in two systems:

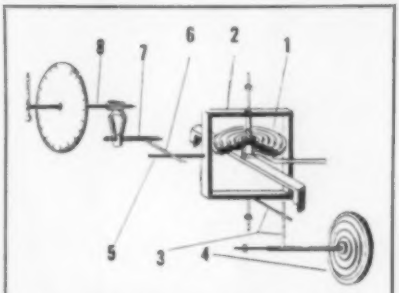
• **Direct reading.** Hot tailpipe gases and inlet air are piped directly to the instrument in the cockpit.

• **Remote reading.** Since long plumbing lines to bring tailpipe gases into the cockpit are often undesirable, Kollsman has come up with a remote Synchrotel indicating system where the basic pressure ratio measuring mechanism is located near the engine. Its movement is accurately transmitted to the cockpit indicator through a 400-cycle servo system which uses magnetic amplifiers.

Both the direct-indication Model 1985 and indirect Model KS 47 indicators are now available at Kollsman.



KOLLSMAN pressure ratio indicator.



HOW PRESSURE RATIO system for turbojet works is shown in Kollsman sketch. As tailpipe pressure diaphragm (1) expands, if lifts frame assembly (2). Angular position of frame is controlled by levers (3) actuated by inlet pressure diaphragm (4). Movement of frame is transmitted by lever (5) to long lever (6) of rocking shaft (7). Movement of rocking shaft is transmitted (8) by gear train and is presented on dial as a ratio of two absolute pressures.

Giant Mobile Crane Lifts 40-Ton Plane

Giant crane designed for Navy BuAer can pick up and move planes weighing 40 tons. Precision hoisting is possible using a remote control device operated by personnel near the crane hook.

The crane's electric generator supplies emergency power for lighting runways, work areas or hangars, the maker states. Designated MB-1, the equipment has a 325-hp. engine. It is over 50 ft. long and more than 13 ft. wide. Extended, boom reaches more than 30 ft.

Manufacturer is LeTourneau-Westinghouse Co., Peoria, Ill.

Said the veteran airline pilot

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Performance and safety certainly are important to you, and the airlines' unanimous confirmation of Champion superiority should guide your choice of spark plugs.

When you fly Champions you fly the best!

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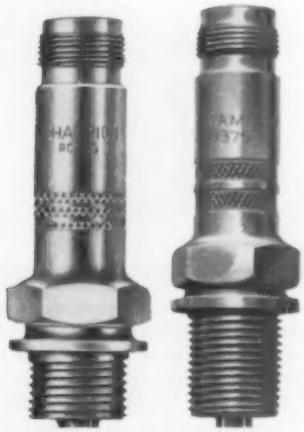

The RC 26 S and R 37 S-1 are most widely used of Champion's complete line of aircraft and jet igniter plugs.

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eliminating linkages and counter-

Quality control is our working partner

Where Titeflex service begins...

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In addition, we're continually working on new metal hose designs to meet the needs of tomorrow's higher powered jets, rockets and guided missles. If you're wrestling with connection problems, consider using Titeflex.

Titeflex

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Titeflex, Inc.
Aviation Products Division
517 Frelinghuysen Avenue
Newark 5, New Jersey

NEW AVIATION PRODUCTS

Markers for Airport Tension Lines

Brightly painted aluminum 20-in. spheres fitted to high-tension lines on airport boundaries provide visual markers for pilots.

Initial installation has been made at Ada, Ohio, Airport. Spheres weigh four pounds and are made in halves that are fastened together over the wire. Recommended spacing is about 20 to 30 ft.

Mutto Manufacturing Co., Canton, Ohio.

Cloudsonde Tells Cloud Level

Cloud altitude levels are sensed and transmitted to ground by a new instrument named the Cloudsonde.

The Cloudsonde also can detect particles such as smoke and dust within predetermined limits, the maker reports.

The equipment can work with present meteorological equipment, it is claimed. **Lucian Laboratories Electronics Division, 220 Darby Rd., Havertown, Pa.**

Counter Altimeter in Production

First units of a new precision counter altimeter have been delivered to U. S. Navy and a large number of the instruments are in production for Douglas Aircraft Co.

High accuracy is maintained throughout the instrument's range and a novel method of balancing acceleration force,

eliminating linkages and counterweights, holds down loss of accuracy due to high G-loads during maneuvering. The altimeter is temperature-compensated in the range from −60 to 160F.

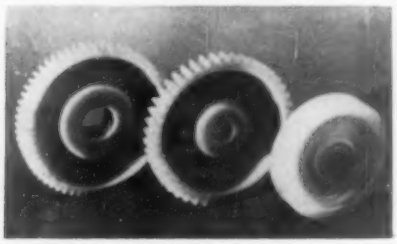
Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y.

Position Light Flasher Weighs 1 lb.

Aircraft position light flasher uses resistance-capacitance network working through two relays to switch the lights at 40-cpm. rate. Unit weighs one pound and measures 4-in. x 2⅛-in. x 3¼ in.

Units meet or exceed USAF MIL-F-7414, the manufacturer reports. Interrupter circuit, operates on 24-v. to 30-cycle d.c., separate from lamp circuits. Radio noise filters are fitted.

Electronic Specialty Co., 3456 Glendale Blvd., Los Angeles 39.



Plaskon Nylon Makes Tiny Gears

Plaskon nylon 8200, a new type of nylon molding compound with aviation applications, has gone into large-scale production.

Aviation uses include wire and cable coating, where it offers high abrasion resistance. The compound's high tensile impact strengths make it a good material to use for small gears or for interior decorating material, the maker says.

Plaskon nylon can be extruded with almost no voids in the finished product.

Barret Div., Allied Chemical & Dye Corp., 40 Rector St., New York.

Tungsten Alloy Damps Vibration

High-density tungsten alloy, almost twice as heavy as lead, is used as counterweights to dampen vibration in aircraft bomb and gun sights. Hevimet can be machined to close dimensional tolerances to maintain balance and hold concentricity, the makers states. A user of the material points out that lead would be too bulky and would provide undesirable physical characteristics in scanning units.

Carboloy Department, General Electric Co., Detroit.

Storage Battery Weighs 1/6th Oz.

A tiny silver-zinc rechargeable storage battery, approximately the size of a postage stamp, has numerous appli-

Quality control is our working partner

Micro-grain size Comparator, used to check samples of production raw materials to specification in the Titeflex Materials Control Laboratory.

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To make our products and service even better, we continually reevaluate our quality standards at home and on maintenance calls in the field. If your requirements are unusual or ultra-rigid, Titeflex engineering service may provide the answers.

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Norwich GLA New York

AIRCRAFT IGNITION AND ELECTRONIC EQUIPMENT

cations in airborne applications, such as voltage reference, radar pulsing, missile controls, intervalometers, telemetering devices and the like, the manufacturer says.

Initial Silvercel units are going into a classified airborne instrument package. The maker expects to have the small battery in mass production within the next few weeks.

The storage cell measures $\frac{1}{16}$x$\frac{3}{8}$x1$\frac{1}{2}$ in. and weighs $\frac{1}{8}$th oz. Capacity is given as $\frac{1}{4}$ amp.-hr., maximum drain rate as about 3 amp. It can achieve peak pulse currents exceeding 2 amp., it is stated. Construction is spillproof and battery is said to have long shelf life.

Yardney Electric Corp., 40 Leonard St., New York 13.

ALSO ON THE MARKET

Permanently crimped forged fibers for packaging are claimed to provide high impact absorption and compression recovery. Material is tradenamed Carbion.—Sherman Paper Products Corp., Newton, Mass.

Portable seam welder works at rate of 200 in. per minute, and over 180-deg. vertical and 360-deg. horizontal axis.—Progressive Welder Sales Co., 3070 E. Outer Drive, Detroit 34.

Surface flow of brazing material can be controlled to hairline accuracy by Nicrobraz Green Stop-Off, the manufacturer states.—Stainless Processing Division, Wall Colmonoy Corp., 19345 John R St., Detroit 3.

Ultrasonic drill for shaping, grinding and polishing of hard and brittle materials provides surface finishes of 18-20 micro-inches. Using 120-mesh abrasive, accuracy of 0.003 in. is claimed.—International Electronics Corp., 81 Spring St., New York 12.

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Fairchild's C-119 Flying Boxcar has joined the key support elements of the Strategic Air Command, the nation's long-range defensive air arm. To the combat proven Flying Boxcar will go new responsibilities for the movement of personnel, equipment and cargo in the global theatre of SAC operations.

Since SAC was organized it has constantly expanded and improved its facilities, and today stands as a symbol of strength in the maintenance of world peace.

The Flying Boxcar, in its role of logistical support of SAC men and planes, will substantially increase the effectiveness of America's front line of defense. Fairchild takes pride in participating in this important Command Performance.

The Strategic Air Command crest, which appears on all SAC planes, depicts force through a mailed fist holding in readiness symbolic lightning bolts of destruction and an olive branch. The white clouds and field of blue sky in the crest symbolize the global capabilities of SAC.

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Solar Energy Could Drive Spaceship's Electrostatic Powerplant, IRE Hears

By Philip J. Klass

An electrostatic powerplant fueled by the sun's energy may power spaceships. This is the view of Dr. Ernst Stuhlinger, ex-German rocket scientist who heads the missile research section at Redstone Arsenal.

The spaceship would be no sleek beauty. It would carry a cluster of 40 or more huge parabolic reflectors for converting solar energy into electric power, giving it the appearance of a "large cosmic butterfly," according to Stuhlinger.

Being unable to develop sufficient power to get off the earth, the spaceship would take off from an earth-satellite.

▶**IRE Symposium**—Stuhlinger's outline of the possibilities of electrical propulsion was presented at an Institute of Radio Engineers' symposium on space station problems held during the recent national convention in New York.

Other symposium papers reported on space station radio relay capable of providing over-ocean transmission of microwave and TV signals, and Mouse, (Minimum Orbital Unmanned Satellite Earth) designed for ionospheric exploration.

The symposium chairman, J. Gordon Vaeth, predicted there would be "mice" in the sky within three to five years.

Interplanetary Travel

Stuhlinger believes interplanetary spaceships will be launched from an earth-satellite and land on a similar station orbiting around the final destination.

On this basis, the entire spaceship structure and its load of fuel will have to be transported to the earth-satellite by "commuter rockets."

If conventional combustion rocket-engines are used to propel the interplanetary spaceship, 170 lb. of fuel must be brought up for every pound of payload to be carried, Stuhlinger says. Thus the major portion of the cost of a trip to Mars would be the expense of transporting propellants from earth to the satellite.

▶**Exhaust Velocity**—Stuhlinger believes that the best, and maybe only, way to reduce this vast amount of fuel is by increasing propellant exhaust velocity.

This is based on the (simplified) equation for rocket velocity:

$$Velocity = (Exhaust\ Velocity) \times Log_e\left(1 + \frac{Loaded\ Weight}{Empty\ Weight}\right).$$

Present rocket engines have exit velocities of 1½ to 2 mi./sec., which may be near the practical limit for chemical fuels, Stuhlinger says. The extremely high temperatures involved in obtaining higher exhaust velocities are beyond the temperature limits of present engine materials.

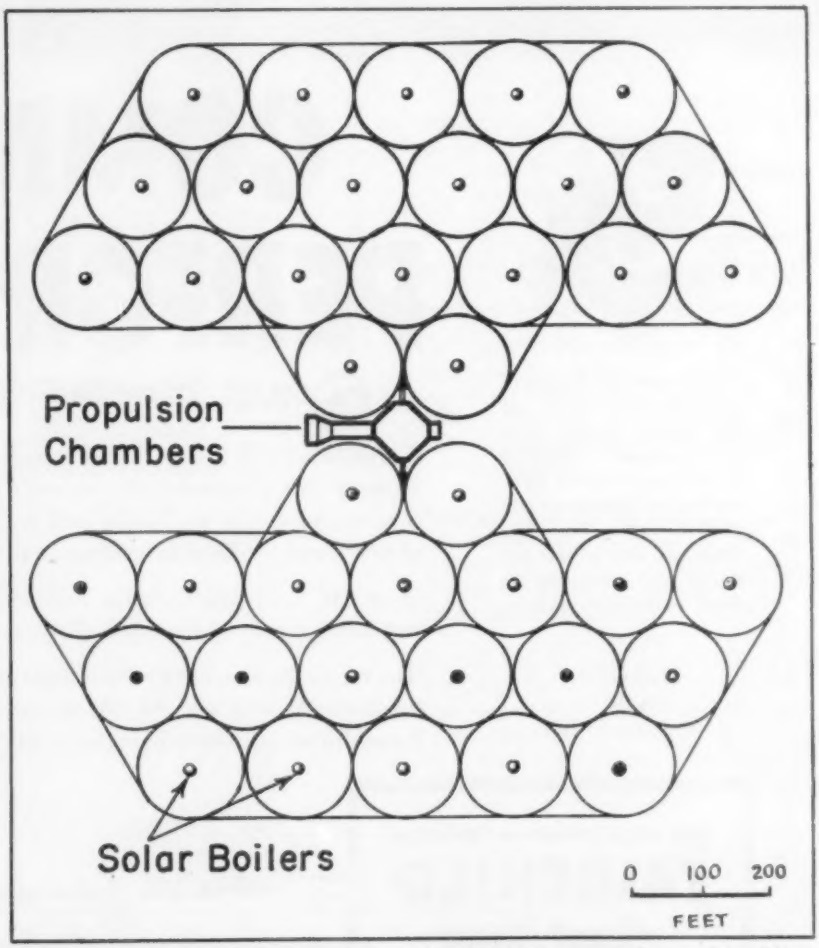
The solution, Stuhlinger suggests, is to accelerate propellant particles by means of a powerful electric field, an idea which he says has been advanced by others.

▶**Tremendous Weight Saving**—The initial weight of an electrically propelled spaceship capable of carrying 10 passengers plus a 50-ton payload to Mars would run only 250 tons, compared to 1,100 tons for a rocket-powered ship, Stuhlinger's figures indicate. Flight time would be approximately one year from earth-satellite to Mars-satellite.

Even more remarkable weight saving would result on a two-year space flight covering some 780 million mi. The electrically propelled ship would start with a weight of only 275 tons, compared to 7,500 tons for one equipped with a rocket engine, Stuhlinger says.

▶**Fundamentals of Electric Propulsion**—In the electrically propelled space ship which Stuhlinger described, conventional fuels are abandoned in favor of materials such as cesium or rubidium.

When atoms of these materials strike an incandescent platinum surface, they shed their outermost electron (which



COSMIC BUTTERFLY might be apt name for electrically propelled spaceship. Mirror clusters that help convert sun's energy to electricity give ship its shape.

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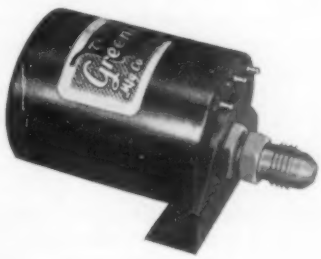

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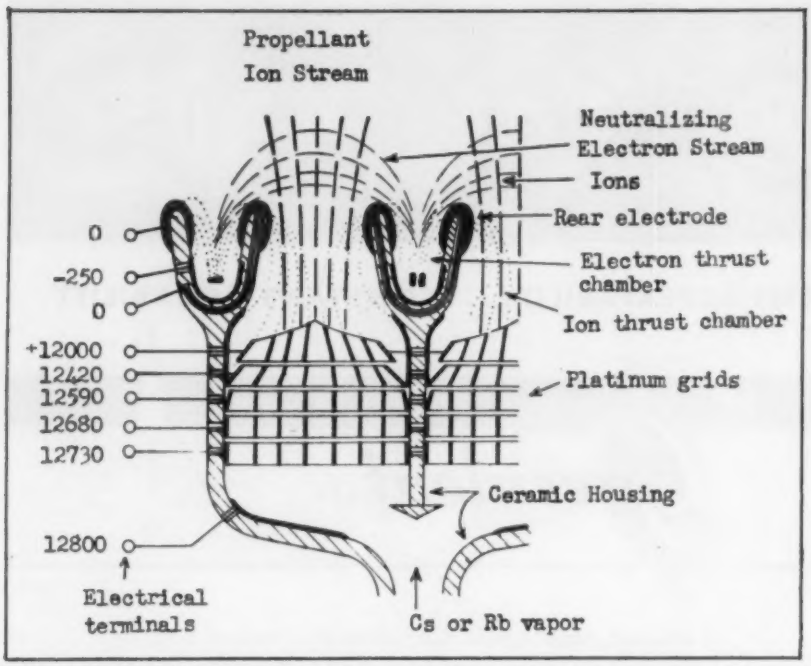


PROPULSION CHAMBER of electrically propelled spaceship, shown in cross-section, uses −250 v. potential to accelerate and discharge propellant ions at exceedingly high velocity.

enters the platinum), leaving positively charged ions.

By using a suitably located negatively charged electrode between the platinum grid and the atmosphere, the stream of cesium or rubidium ions can be accelerated and discharged to the atmosphere at extremely high velocities, creating propulsive forces on the space ship.

To prevent the spaceship from building up a negative charge (from electrons split off during the ionization process), electrons must also be expelled to the atmosphere. Added requirement is that the ions and electrons must be discharged simultaneously and at the same rate, Stuhlinger says.

▶**Space-Charge Effect**—Unless the charge on the discharged ions is neutralized shortly after leaving the propulsion chamber, the accumulated charge will tend to repel or slow down other ions being discharged from the chamber, limiting the rate of ion discharge. This space-charge effect is similar to that experienced within electron tubes.

The space-charge problem can be countered by combining the positively charged ions and the electrons shortly after the two are discharged.

▶**Electric Power Needed**—The product of ion current and the voltage required to accelerate and discharge the propellant from the propulsion chamber represents power which must be provided from within the spaceship. Stuhlinger's model requires 7,000 to 8,000 kw. of electric power for this purpose.

Stuhlinger rejects any conventional power source, including an atomic energy pile, as being far too heavy to generate this amount of power over a period of a year or more (required for space travel).

▶**Free Power Available**—Solar energy, however, is a source of free power available in outer space. An area of 1 sq.m. receives about 1 kw. of solar energy. To put this to use, Stuhlinger proposes to use forty 50-ft.-dia. parabolic mirrors to concentrate the sun's rays on boilers located at their focal points. Steam formed in each solar boiler would then power a small (200-kw.) turbo-generator.

Each turbo-generator and associated condenser would be mounted back of the mirror (shielded from the sun's rays) on a common axis with the boiler. The entire power package would rotate slowly around the common axis, making the condensate flow to the edge where it would be pumped back to the boiler (see sketch, p. 81).

The use of a large number of small turbo-generators, instead of fewer units of larger capacity, simplifies spaceship construction and makes it less vulnerable to serious power loss in the event it suffers a hit from a small meteor.

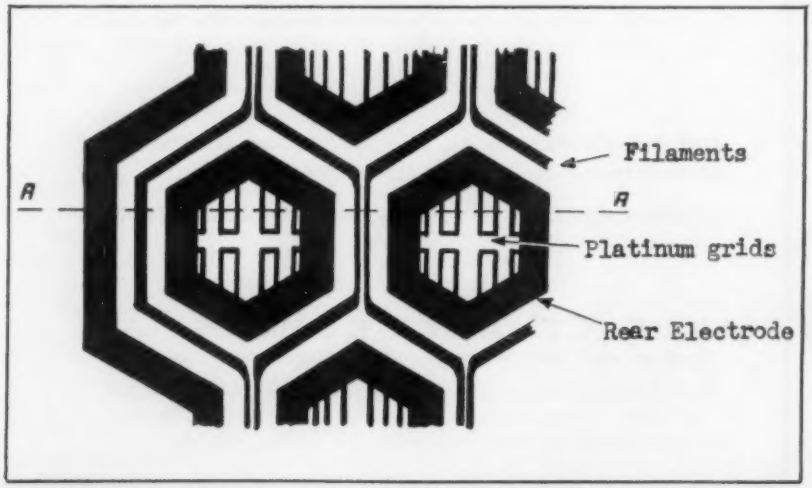
A power source employing thermoelectric couples, or solar batteries, would be far simpler than the turbo-generator powerplants, but the present efficiency of a thermocouple is only 10% of that obtainable with turbo-generators, and semi-conductors now employed in solar batteries deteriorate under continuous cosmic ray bombardment. By the time a spaceship such as Stuhlinger proposes is ready to be built, these factors may have been improved.

To obtain the most efficient overall propulsion involves the optimization of many factors, Stuhlinger said. These include: choice of propellant, accelerating voltage, size of ion sources and propulsion chambers, and the upper and lower temperature levels of the turbine.

For instance, a larger condenser provides more efficient turbine operation, but increases the overall mass of the powerplant and spaceship, reducing propulsive efficiency.

▶**Propulsion Chambers**—Stuhlinger's spaceship would employ approximately 1,000 hexagonal-shaped propulsion chambers, each measuring approximately 2 in. across. These would be clustered together in honeycomb fashion (see sketch, left).

Cesium or rubidium vapor would enter the individual propulsion chambers, each of which would contain a series of electrically heated grids of platinum foil. A negative accelerating voltage (−250 v.) would be applied to a coil near the output orifice of each chamber. Other coils, surrounding the platinum grids, would have high (12,000-v.) positive potentials applied, to shape and concentrate the ion stream to prevent



A THOUSAND propulsion chambers, clustered honeycomb fashion, will provide thrust.

PRECISION SUBCARRIER DISCRIMINATOR

• FOR MULTIPLEXED FREQUENCY MODULATED INSTRUMENTATION SYSTEMS

Performance obtained from EMR's new Model 67 Precision Subcarrier Discriminator indicates that it will supersede existing subcarrier discriminators used in frequency modulated telemetering and data recording systems, and will establish new standards for systems now in design.

The new instrument incorporates a Band Pass Input Filter, Frequency Determining Network, and an interchangeable Low Pass Output Filter in a single front panel plug-in unit. Three outputs are provided, one of which will drive most pen motors to full deflection. Each discriminator contains its own electronically regulated power supply.

The Model 67 Discriminator is linear within 0.1%, slope is constant to ±0.25%, and long-term zero drift does not exceed 0.5% (all referred to full bandwidth). Wide range base line limiting of the subcarrier eliminates amplitude modulation effects and reduces the effect of step function changes encountered in magnetic tape dropouts to a minimum.

Of special interest is the fact that this discriminator provides constant time delay of intelligence through a subcarrier channel, permitting reduction of recorded or transmitted multiplexed data occurring at max. intelligence frequencies with errors of less than 1% of bandwidth. Complete compensation for speed change error in tape recorded data can be provided.

Further information, including detailed characteristics of the instrument, may be obtained by writing Sales Engineering Department, Electro-Mechanical Research, Inc., Ridgefield, Conn.

CHARACTERISTICS

The basic discriminator unit is operable over the frequency ranges and deviations stated. The Channel Selector unit, including Band Pass Input Filter, Frequency Determining Network, and Output Filter establish subcarrier center frequency, deviation, and intelligence bandwidth.

Frequencies available	400 cps to 100 Kc.
Subcarrier frequency deviation	Up to ±50% of Center Frequency.
Intelligence frequency	From DC to as much as 30% of Center Frequency.
Harmonic distortion	Less than 1%.
Input impedance	0.5 megohms shunted by approx. 20 mmfd.
Input range	Dynamic range for any input level setting is 30 db. 10 mv minimum input.
Amplitude modulation and tape drop out	50% square wave amplitude modulation of subcarrier results in change in output amplitude equivalent to less than 1% of bandwidth.
Output	Single ended and referred to ground. Will drive most pen motors or other recording devices to full scale.
Output limiters	Output amplifier is designed to limit at ±20 ma.
Linearity of output vs subcarrier frequency	Within 0.1% of bandwidth.
Output stability	Zero drift does not exceed 0.5% of bandwidth in a 15-hour period.
Sensitivity stability	Within ±0.25% of bandwidth.
Max. output noise	Equivalent to less than 0.1% of bandwidth.
Power source	105-125 volts, 60 cps, 170 watts, unregulated.

Speed change error compensation analysis for system using Model 67 Discriminator

$$N_r = \frac{N}{100}\sqrt{1 + .0042\left(\frac{f_c}{f_d}\right)^2 I^2}$$

where

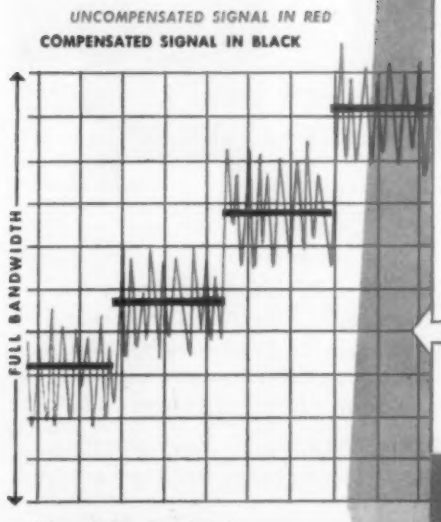
N_r = peak to peak residual wow or flutter component after compensation at frequency f_c in percent of bandwidth ahead of low-pass output filter.

N = peak to peak amplitude of uncompensated wow or flutter component at frequency f_c in percent of bandwidth.

f_c = wow and flutter frequency component under consideration, in cps.

f_d = one half of bandwidth for channel in question, in cps.

I = carrier offset from center frequency in percent of half bandwidth.



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its hitting the negatively charged accelerating electrode.

Surrounding the discharge orifice of each chamber would be a hot filament discharging electrons (much like an electron tube cathode) into the atmosphere to neutralize the charge of the ion stream. Neutralization would take place approximately 1 in. behind the chamber's orifice. Filament temperature would be controlled automatically to produce the same number of electrons and discharged propellant ions.

▶**Spaceship Limitations**—Because of limits imposed by space-charge effects and the low ion currents which can be achieved (550 amp.), the electrically propelled space ship which Stuhlinger described would achieve accelerations of the order of only 1/10,000G.

This appears to limit its application to interorbital vehicles which start and end their flights in space where their weights are zero, Stuhlinger says.

Unlike rocket ships which coast through most of their voyage, the low thrust available from electrical propulsion requires its use throughout the trip. During the first half of the trip, the thrust developed would be used to accelerate the space ship; during the last half, the ship would turn 180 degrees and employ its thrust for deceleration, Stuhlinger said.

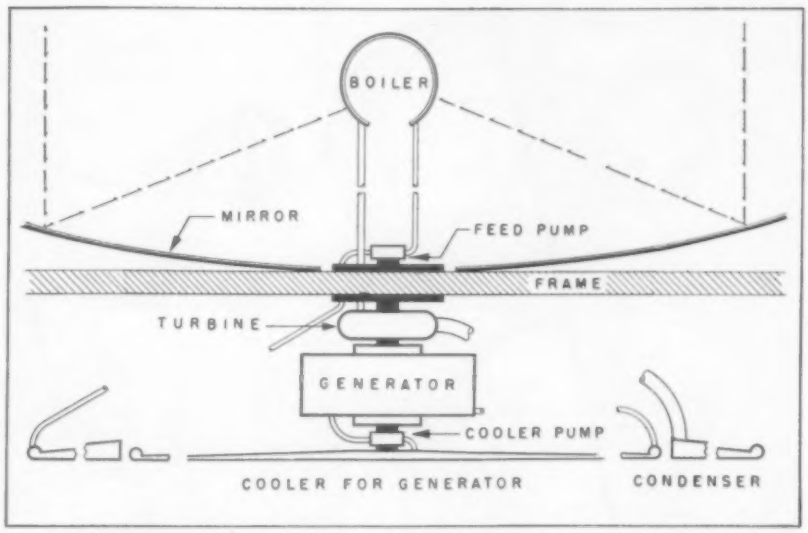
Space Station Relay

A space station out 22,000 mi. equipped with a 100-ft.-dia. microwave "mirror" could successfully bounce TV signals across the ocean, employing only a 50-kw. transmitter on the earth. This was one of several possible space station relays described by Dr. John R. Pierce, director of electronics research at Bell Telephone Labs (see also AW Mar. 28, p. 34).

▶**Many Channels.** To emphasize the economic value of such a relay station, Pierce said that a 36-channel (two-way) trans-Atlantic phone cable costs around $35 million, and that the space relay station could provide 30 times as many channels.

The several possible space station relays which Pierce described were based on the following operating requirements: 10-cm. wavelength; 40-mc. RF bandwidth (employing single side band); 5-mc. video bandwidth; pulse-coded modulation, employing an eight-bit code; 20-db. RF signal-to-noise ratio; 6-db. RF noise figure for the terminal receiver;—102-dbw. received RF signal; and 250-ft.-dia. antennas at earth terminal points.

▶**Far and Near**—If the satellite were a 1,000-ft.-dia. sphere made of suitable reflecting material, it could bounce signals across the ocean if orbited at a distance of 22,000 mi. from the earth, Pierce said.



SOLAR POWERPLANT for spaceship would employ parabolic mirror to focus sun's rays.

At this distance, it would have the same period of rotation as the earth, effectively remaining fixed relative to earth terminal points. However, at this distance an extremely high-powered (10-megawatt) transmitter would be required on the earth to provide required signal strength at the other terminal.

This power could be greatly reduced (to 100 kw.) if the station orbited at 2,200 mi., but then it would have a shorter orbit period, causing its position to shift relative to the earth terminal stations. Thus several space relays would be needed to assure that one of them was always within sight of the ground terminals.

▶**Other Possibilities**—To get around these limitations, Pierce considered the possibility of a smaller satellite, 22,000 mi. out, carrying a 100-ft.-dia. microwave mirror.

This would permit earth transmitter power to be cut to 50 kw., but imposes orientation problems. The mirror must be continuously maintained in the proper orientation relative to the earth terminals within 1/20 degree, Pierce's calculations indicate. He suggested some sort of automatic servo control to take out any satellite orbit perturbations caused by sun and moon gravitational effects.

The orientation requirement could be eased if the satellite were equipped as a microwave repeater station, to receive and rebroadcast the earth signal. If this were possible, earth transmitter power could be reduced to 100 watts. The satellite, using a 10-ft.-dia. antenna, would transmit a very low (30-milliwatt) signal to the end terminal. By this means, an orbit deviation of as much as 360 mi. or an antenna tilt of as much as 0.95 degree could be tolerated, Pierce said.

By going to directional dipole arrays on the satellite and increasing its power, orientation problems could be further eased, Pierce indicated. He concluded that when satellite space stations are practical, the radio relay service should add little to the cost or complexity of the satellite.

Space Mouse

A tiny unmanned earth satellite, little more than a foot in diameter and orbiting 200 mi. out, could provide much useful information on cosmic radiations which never get through the earth's atmosphere, S. F. Singer told the IRE.

Singer, a physics professor at the University of Maryland, described a "minimum orbital unmanned satellite of the earth," called "Mouse" for short. It would consist of a cylindrical case, housing instrumentation, spinning on an axis like a gyroscope wheel to give it spatial stabilization.

Carrying a 50-lb. payload, Mouse would follow a gradually shrinking elliptical path which would bring it down to earth in a few days or weeks, depending upon its starting altitude. Despite a relatively short life, Mouse would pay for itself in the upper atmosphere data it could provide, Singer believes. It would be equipped with cosmic ray, aurora particle, and Geiger counters, a magnetometer to measure earth's magnetic field, and other types of instrumentation.

▶**Mouse Avionics**—Mouse would circle the earth every 90 min. Measurements made during an orbit would be stored on magnetic tape or drum, then telemetered down to earth in a quick burst when Mouse passed over the receiving station, Singer indicated. An FM/FM telemetering system might be used, but there may be problems arising from Doppler frequency shift due to satellite

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velocity and ionospheric refraction, Singer said.

Electric power to operate Mouse's telemetering transmitter, and a small radar beacon to permit tracking by earth-based radars, will come from the sun's rays, via solar batteries. (Supplemental storage batteries would be used to handle peak loads.)

By selecting an orbit which takes Mouse over both poles, one side of the satellite, containing the solar batteries, would always face the sun. Admitting that cosmic radiation deteriorates the semi-conductor now used in solar batteries, Singer said that this should not prove a serious problem because of the short duration of exposure.

▶ **How Soon?**—Small unmanned satellites of this type are capable of being built today, and at a cost in line with current research spending, symposium chairman Vaeth said, and may be in the air within three to five years. Vaeth is with the Navy's Special Devices Center.

He emphasized that the opinion is a personal one and does not necessarily reflect Navy's views, however.

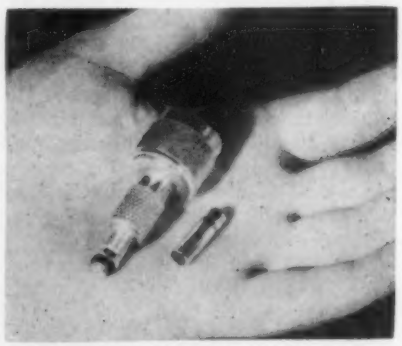
New Avionic Diode Simplifies Design

A new silicon diode with extreme broad-band characteristics has been developed by Sylvania Electric for use in radar receivers, beacons, and countermeasures equipment. It is designed for video detectors and mixers in the 1 to 12.4-kmc. range.

Unusual construction in the new diode reportedly permits considerable simplification in the associated crystal holder or co-axial "T" mixer. The new type construction, called "Tripolar," provides three crystal connections instead of the usual two.

When used as a video detector, the IF signal is fed into a center conductor on one end of the crystal and the video output signal comes out from a terminal on the other end. (The metal crystal shell forms the third terminal.)

When used as a mixer, the RF and



NEW TRIPOLAR DIODE (right) makes possible simplified holder (left).

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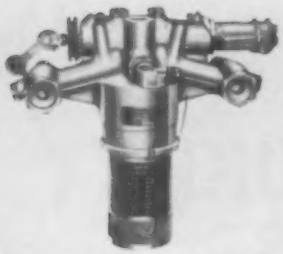

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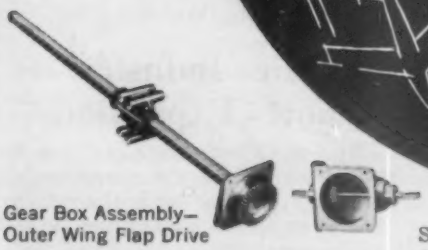
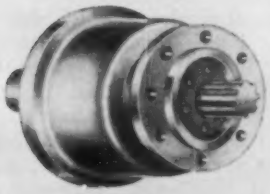


Gear Box Assembly—
Outer Wing Flap Drive

Gear Box



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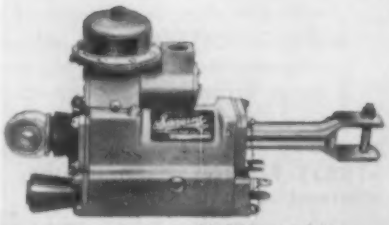

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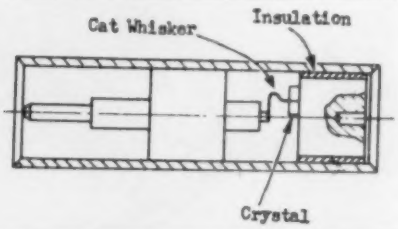


TRIPOLAR DIODE construction details.

local oscillator signals are introduced at one end, completing the circuit to the metal shell, while the resulting IF signal comes out the other end. The new Tripolar construction makes the crystals essentially a series instead of shunt-type device.

Sylvania presently is in pilot production on three types of Tripolar crystals suitable for video detector use, with mixer crystals slated for production soon.

The three video crystals now available can be operated over a temperature range of −40 to 70C, and reportedly have a minimum figure of merit (in an untuned broadband holder) of 10 at 6.75 kmc., a tangential sensitivity of −40 dbm. over the frequency range. Characteristics of the individual types, at 25C are:

- **IN358:** 1-12.4 kmc.; 4,500 ohms, video resistance; no built-in d.c. return.
- **IN369:** 3-12.4 kmc.; 18,000 ohms video resistance; built-in d.c. return.
- **IN369A:** 1-2.4 kmc.; 19,000 ohms video resistance; built-in d.c. return.

Application engineering data is available from Sylvania Electric Products, Electronics Div., Woburn, Mass.

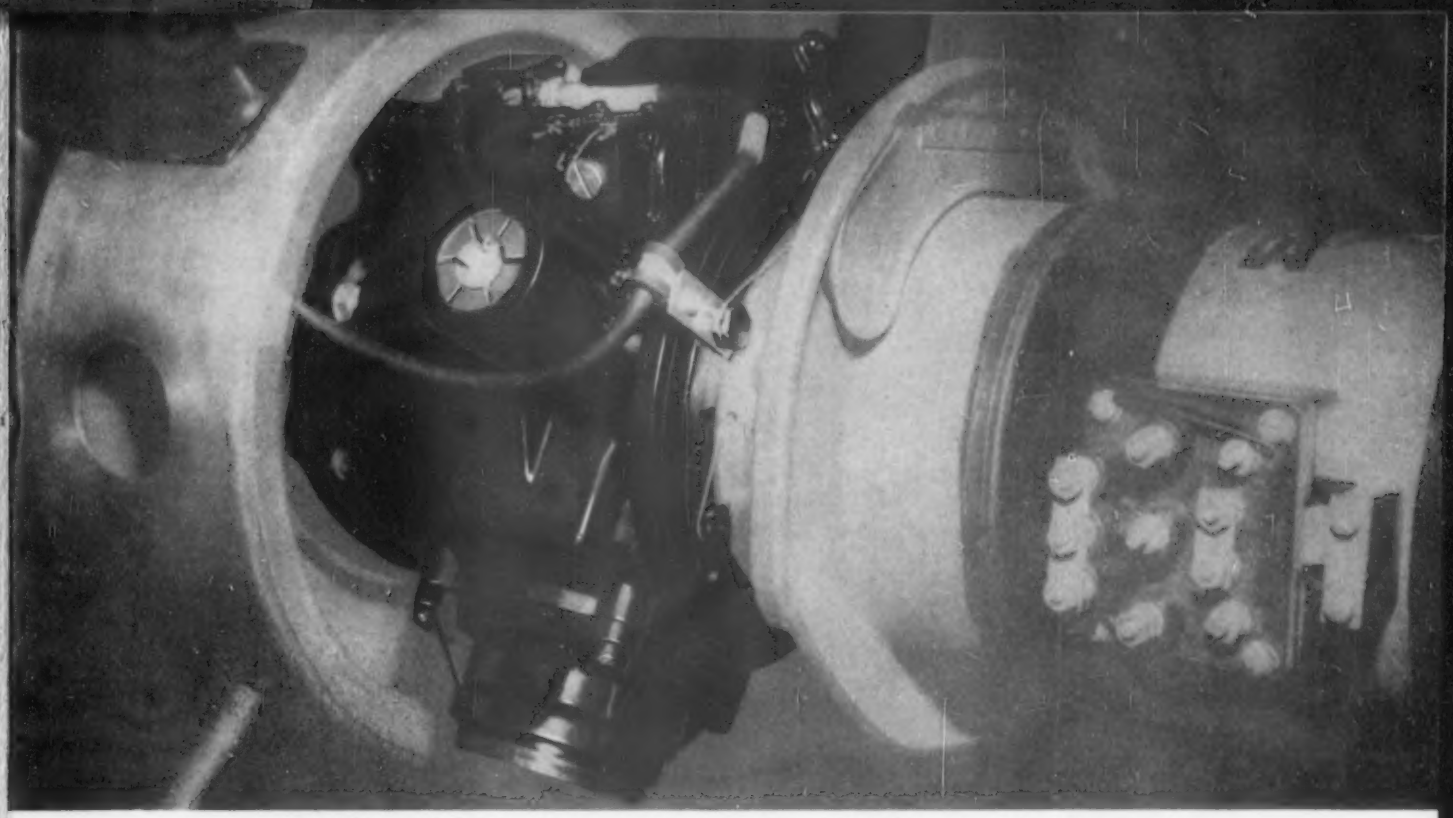
Avionics Industry Reports Expansions

Hoffman Electronics Corp., Los Angeles, has entered the computer field with the purchase of Analyzer Corp., analog computer manufacturer located in the same city.

By the transaction, Hoffman acquires all rights to the Nordsieck mechanical differential analyzer which has been used by North American Aviation and several universities. Albert S. Cahn, former president of Analyzer Corp., joins Hoffman as a consultant. Hoffman expects to turn out its first production model within six months.

Other avionics industry expansions include:

- **Mack Trucks, Inc.,** has acquired White Industries, Inc., and Radio Sonic Corp., New York avionics manufacturers as the first major step in a long-range company diversification program. The two new additions will become the Electronics Division of Mack Trucks. Key executive posts in the new division will be filled by Robert



Lightweight General Electric constant speed drive mounts directly to A4D Skyhawk engine's single nose pad.

How G-E drive provides jet engine starting and a-c power from one engine pad

Having only one engine pad available for both jet engine starting and a-c power, Douglas Aircraft faced a difficult problem in the design of the A4D Skyhawk. The flexibility of the General Electric 9 KVA hydraulic constant speed drive permitted the addition of starting gears with no performance penalty and only a small increase in weight.

Ideal for airborne applications, the G-E constant speed drive features a ball piston design that provides light weight and high reliability due to the small number of moving parts and simple mechanical operation. Drives can be supplied from 9 KVA to 60 KVA for most engine speed ranges.

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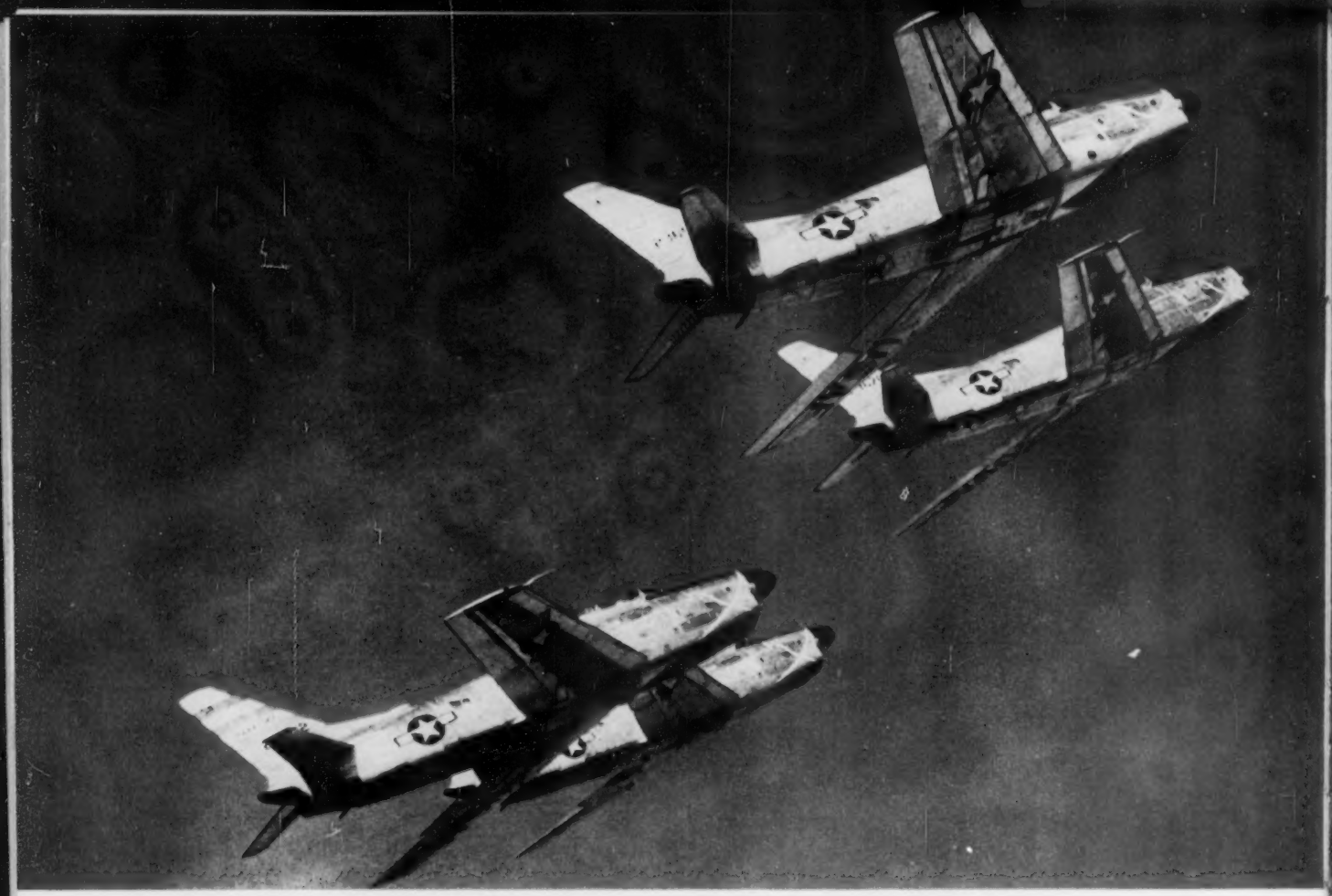

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30% INCREASED AVAILABILITY

At Hamilton AFB, California, special jet engine maintenance crews cut 325th FIS operating costs, manpower requirements

The Air Force's 325th Fighter Interceptor Squadron now has a ***30% higher North American Aviation F-86D "in commission" rate*** and its maintenance costs and manpower needs have been reduced. These benefits are a direct result of entirely new J47 engine maintenance procedures initiated by personnel of the 325th and G-E jet service engineers.

ONE USAF MAINTENANCE CREW, for example, now handles the squadron's J47 engine removal and replacement work. Previously, many F-86D crews were used for this job. But the new "special" crew—besides reducing manpower requirements—has cut engine removal time to as low as 30 minutes!

A SPECIALIZED 7-MAN RUN-UP CREW also handles engine testing for all squadron aircraft after the F-86D's have been reassembled following inspection. Before, 20 men handled all squadron run-ups.

Savings realized by the 325th are but another example of how G-E jet service engineers are constantly co-operating with the Air Force. To G-E jet representatives in the field—increased aircraft availability and reduced jet engine maintenance time are prime objectives. 232-8

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1. HAMILTON AFB MAINTENANCE SYSTEM IN OPERATION. In this typical case history, a G-E J47 is removed for routine check. Trouble is suspected. Engine sent to test . . .

2. J47 CELL TEST indicates a need for further check of the control system. So G-E tech reps (above) recommend an electronic engine simulator test . . .

3. SIMULATOR EQUIPMENT evaluates the J47's integrated electronic control operation, finds a compressor discharge pressure sensor unit to be out of tolerance . . .

4. NEW CDP SENSOR, picked up at the Squadron's spare parts stock room, will be installed to complete engine minor repair, ready J47 for reinstallation . . .

5. FINAL TESTING. A special seven-man run-up crew checks J47 out in F-86D. By using a single crew for all J47 run-ups, the 325th Fighter Interceptor Squadron at Hamilton has reduced the number of personnel required for run-ups by two-thirds.

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These recently developed aircraft pressure switches cover operating points within the entire range of inches of water through 3000 psi. Construction materials are compatible with operating media encountered in current and foreseeable aircraft applications. Design features permit all switches to meet or to exceed the requirements of MIL-E-5272A and other applicable performance specifications. The three illustrated here are widely adaptable for specific applications — demonstrate the high performance standards of our complete line.

Our long experience and extensive facilities for developing, manufacturing and testing pressure switches for modern aircraft can be helpful to you. Engineering counsel is at your service. Please direct your inquiry to our headquarters plant, Danbury, Connecticut.

Differential Pressure Switch, Type 6840

DIFFERENTIAL ADJUSTMENT RANGE: 10 to 50 inches of water. **RESET VALUE:** 1.5 inches of water. **EXTERNAL ADJUSTMENT:** Doubly locked. **TEMPERATURE RANGE:** Minus 65° F. to plus 165° F. **WORKING PRESSURE:** 5 psig maximum. **PROOF PRESSURE:** 10 psig without setpoint drift. **VIBRATION:** Models available capable of meeting MIL-E-5272A Procedure I. **OVER-ALL DIMENSIONS:** Height 4-3/16", Width 6⅛", Length 6⅛". **WEIGHT:** 1 lb. 10 ozs.

Pressure Actuated Switch, Type 6885

PRESSURE ADJUSTMENT RANGE: 0-10, 10-50, 50-100 psi. **ACCURACY OF SETTING UNDER ALL TEST CONDITIONS:** 0.5 psi at 5 psi setting; 4% at 50 psi setting; 3% at 100 psi setting. **EXTERNAL ADJUSTMENT:** Knurled nut doubly locked. **TEMPERATURE RANGE:** Minus 65° F. to plus 250° F. **PROOF PRESSURE:** 750 psi without setpoint drift. **VIBRATION:** Up to 2000 cps. at 20g. Integral vibration isolation provided between mounting bracket and switch body (see illustration). **OVER-ALL DIMENSIONS:** Switch proper 2" diameter. Length 4⅜". Mounting bracket to suit application. **WEIGHT:** 9 ozs.

Hydraulic Pressure Switch, Type 6891

PRESSURE ADJUSTMENT RANGE: 500 to 3000 psi. **ACCURACY OF SETTING:** ±60 psi. **RESET VALUE:** 100 psi. **TEMPERATURE RANGE:** Minus 65° F. to plus 275° F. **PROOF PRESSURE:** 4500 psi without setpoint drift. **VIBRATION:** MIL-E-5272A Procedure I. **OVER-ALL DIMENSIONS:** Height 2¼". Width 2¼". Length 4-19/64". **WEIGHT:** 15 ozs.

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G. Kramer and G. E. Pray, former heads of the two concerns.

• **ElectroData Corp.**, Pasadena, Calif., maker of computers, will build a new 40,000-sq. ft. plant in Pasadena to be located at 460 No. Sierra Madre Villa. Slated for completion in August, plant will more than double firm's previous production facilities.

• **Westinghouse Electric's** Electronics division will build a 350,000-sq. ft. plant adjacent to the company's Air Arm division at Friendship Airport, Baltimore. Full occupancy and operation is expected by next January.

• **Topp Industries, Inc.**, Los Angeles, has merged with Bonner Machine Works, Inc., avionic systems manufacturer. B. F. Gira, president of Bonner, will become president of the new merged operation, while H. J. Petersen, former president of Topp, becomes executive vice president.

• **Dallas Avionics, Inc.**, Dallas, manufacturer and distributor of aircraft communication equipment, has been elected to membership in RTCA.

• **General Electric's** Heavy Military Electronic Equipment Dept. will erect a new 69,000-sq. ft. addition to its "systems center," to house marketing and engineering activities. Occupancy is expected by the end of this year.

FILTER CENTER

▶ **Texas Is Happy**—Texas Instruments, Inc., is now the nation's (and probably the world's) largest producer of transistors, according to a company official. TI also is the country's only source of high-temperature silicon transistors in production quantities, a distinction it has held for nearly a year but which competition may soon force it to relinquish. Under Signal Corps sponsorship, TI is developing three new types of silicon transitors.

▶ **Boeing Arouses Curiosity**—Boeing exhibit at the recent national IRE show in New York aroused considerable curiosity, because the company had no avionic equipment or products on display and had nothing to peddle except an idea. Boldly set out over a vibrating two-dimensional plywood model of the Bomarc missile were the slogans: "Guided missiles are rough on electronic components," and "Vibration—just one problem in missile electronics design."

▶ **Transistor Bibliography Available**—"Transistors and Their Applications," a bibliography covering the period of 1948-53, is available gratis as long as the supply lasts. Write to Technological Institute Library, Northwestern University, Evanston, Ill.

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AVIATION CALENDAR

Apr. 27-29—Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Los Angeles.

Apr. 27-30—American Helicopter Society, 11th annual forum, Hotel Mayflower, Washington, D. C.

Apr. 28-29—Michigan Aeronautical Conference, University of Michigan, Ann Arbor.

Apr. 29—Institute of Navigation, eastern regional meeting, Friendship Airport, Baltimore.

Apr. 29-30—New England radio-electronics meeting, sponsored by Boston and Connecticut Valley sections of IRE, Sheraton Plaza Hotel, Boston.

Apr. 30—Air Force Assn., Illinois Wing convention, Sheraton Hotel, Chicago.

May 2-5—Society of Aeronautical Weight Engineers, national conference, Hilton Hotel, Ft. Worth.

May 3-5—Instrument Society of America, first national Flight Test Instrumentation Symposium, Allis Hotel, Wichita.

May 4-6—Fourth International Aviation Trade Show, 69th Regiment Armory, New York.

May 5—First International Aircraft Mart Exposition, Will Rogers Memorial Coliseum, Ft. Worth.

May 5-7—National Inter-Collegiate Flying Assn., annual convention and air meet, Meacham Field, Ft. Worth.

May 7—American Rocket Society, New York Section meeting, Picatinny Arsenal, Dover, N. J.

May 7-8—Association of Northeastern College Flying Clubs, annual inter-collegiate air meet, Troy (N. Y.) Municipal Airport.

May 9-11—National Conference on Aeronautical Electronics, Biltmore Hotel, Dayton.

May 16—National Fire Protection Assn., annual aviation seminar, Netherland Plaza Hotel, Cincinnati.

May 16-20—National Materials Handling Exposition, produced by Clapp & Poliak, International Amphitheater, Chicago.

May 18-19—Air Navigation Development Board, technical symposium on the common system radar beacon, Washington, D. C.

May 18-20—National Telemetering Conference, Morrison Hotel, Chicago.

May 19—Royal Aeronautical Society, 43rd Wilbur Wright Memorial Lecture, Royal Institution, London. Lecturer: Dr. C. S. Draper, head of the Department of Aeronautical Engineering at Massachusetts Institute of Technology.

May 19-21—Armed Forces Communications Assn., global communications conference, Commodore Hotel, New York.

May 23-24—American Society for Quality Control, ninth annual convention, Hotels Statler and New Yorker, New York.

May 28-30—Eastern States Soaring Assn., championship contest, Wurtsboro, N. Y.

May 30—Federation Aeronautique Internationale and KNVvL Royal Netherlands Aeroclub, fifth International Air Display, Ypenburg Aerodrome, The Hague.

May 30-June 4—Aviation Writers Assn., 1955 annual convention, King Edward Hotel, Toronto.

June 4—Reading Aviation Service, sixth annual Maintenance and Operations Meeting, Reading, Pa.

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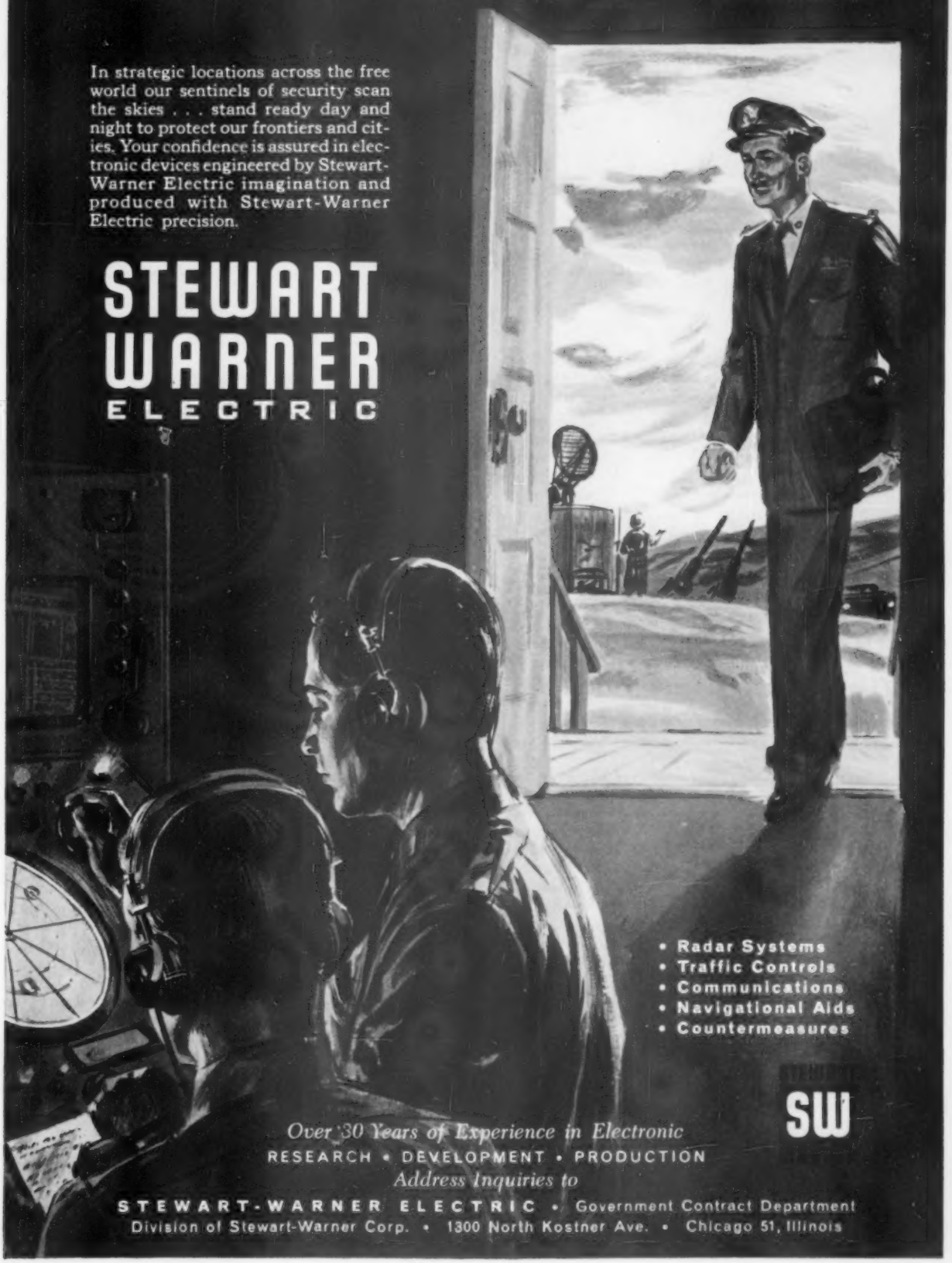

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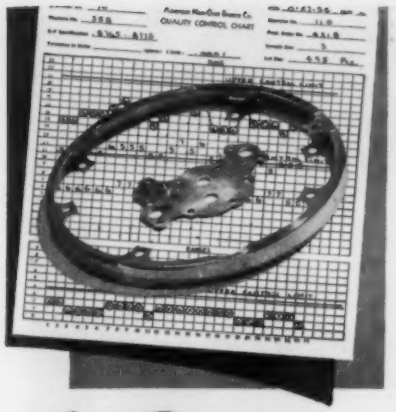

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FINANCIAL

Trend in Aircraft Earnings

	Number of Companies	Reported net Income After Taxes (000)	Book Net Assets Jan. 1, (000)	Percent Return on Sales	Percent Return on Net Assets
1948	27	$ 17,721	$601,773	1.4	2.9
1949	27	47,370	580,594	3.3	8.2
1950	29	84,585	592,613	4.5	14.3
1951	33	62,679	686,747	2.2	9.1
1952	37	127,167	712,084	2.4	17.9
1953	38	176,273	875,191	2.4	20.1
1954	38	271,983	990,883	3.8	27.4

* Prime builders and parts manufacturers.
SOURCE: National City Bank Letters, National City Bank, New York

Aircraft Profit Rise Best in U.S.

Aircraft industry earnings for 1954 were outstandingly good. They showed higher gains over 1953 than all other industrial groups.

This accomplishment stands out in the annual summary put out by the First National City Bank of New York (formerly National City Bank), a recognized source in measuring earnings and rates of profitability for all industry. For 1954, it covered 3,442 companies.

▶ **Big Jump**—The aircraft group—38 prime builders and parts manufacturers—recorded a new peak in net income after taxes. Net was $272 million, up some 54% over 1953. This is in keeping with the expectations spelled out in this space last year (AW May 10, 1954, p. 83).

The gain was by far the best among industrial groups—all manufacturing companies (1,778) averaged a 4% increase in net income for 1954 over 1953—but percentage return on sales was only 3.8, compared with 5.9% for all manufacturing companies.

The sharp gain in net income was largely due to the complete lapse of the excess profits tax for most companies. (Corporations on a fiscal year basis felt EPT for a limited period during the year.)

The 3.8% average net profit margin for the aircraft group compared to 2.4% in 1953. For all manufacturing enterprises, the 5.9% net profit margin compared with 5.3% the previous year.

Aircraft profit margins were higher in 1950—then the average figure was 4.5%. The accompanying table shows the trend for the years 1948-1954, as reported by National City.

▶ **Not Always High**—The tabulation shows that the aircraft industry has not always been prosperous and only in recent years has been able to generate real earning power.

For example, in 1948, just emerging from the postwar slump, the industry (some 27 companies) showed $17.7 million in aggregate earnings. But rapid increases in earning power continued, until 1954 results showed a better than 15-fold gain over 1948.

At no time were net profit margins on sales excessive; in fact, they have been consistently below the average experience of all manufacturing corporations. But increasing and sustained volume of sales (with the added impact in 1954 of no EPT) has made possible a rising curve of earnings.

▶ **Return on Assets**—In still another measure, the aircraft group did quite well last year. This is the percentage return on net assets.

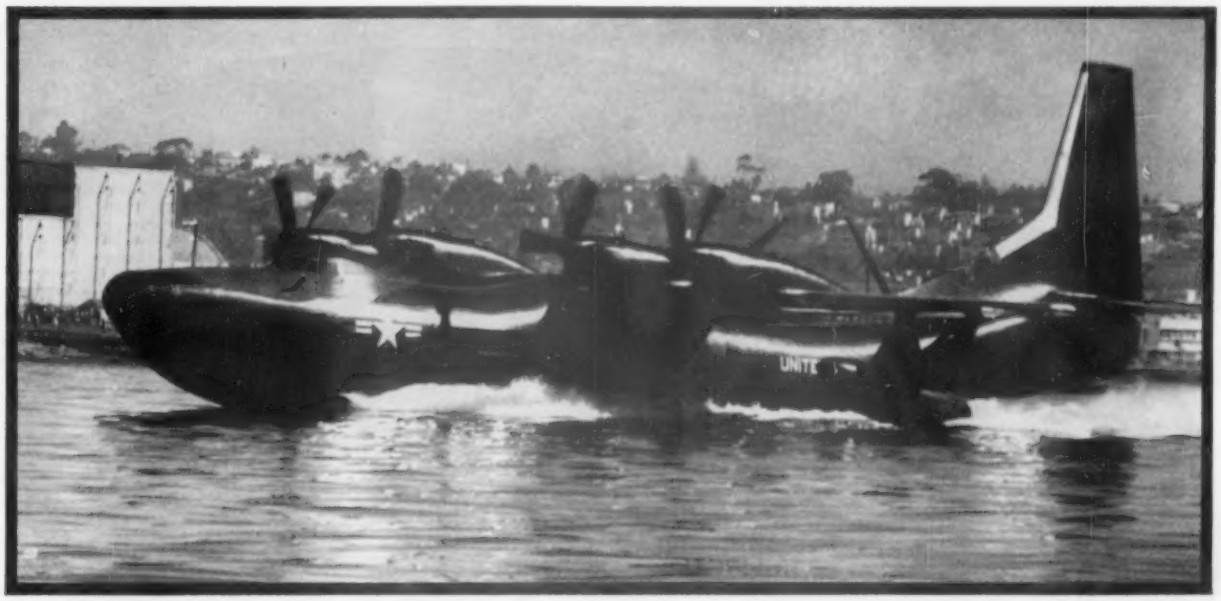
For 1954 the 38 aircraft companies in the National City Bank compilation showed a return of 27.4% in this respect as compared to 20.1% for 1953. In both years this was the highest of any of the industrial categories shown. All manufacturing groups averaged only 12.4% on their book valuations last year.

But it is important to note that for many years the aircraft industry has experienced far lower and even submarginal returns on the investment.

Another interesting trend that can be observed is that the aircraft industry has consistently maintained its capital expenditures, thus constantly augmenting its property accounts. In other words, the aircraft industry is becoming less dependent on facilities obtained under government lease.

▶ **Valuation and Depreciation**—Book valuation and the return realized on it may have specious qualities in measur-

Another turboprop first by Aeroproducts!



NAVY R3Y TRADEWIND WITH AEROPRODUCTS TURBOPROPS COMPLETES RECORD HOP!

Convair eighty-ton cargo-transport, powered by Allison gas turbine engines and Aeroproducts turbopropellers, flies coast to coast in six hours for seaplane record

Aeroproducts turbopropellers made flight history again February 24 when they helped power the Navy's giant R3Y Tradewind on the first cross-country hop of a turboprop seaplane. The 80-ton Tradewind flew non-stop from San Diego, California, to Patuxent River, Maryland, in six hours.

A cargo transport, the R3Y sets the trend toward wide use of turboprop engines and turbopropellers. This pioneering flight also marks another first for Aeroproducts. In 1945, an Aeroproducts turbopropeller was used on a Convair F-81 in the first flight of a turboprop-powered plane in the United States. In fact, Aeroproducts turbopropellers have more flight time than any other American-made turbopropellers.

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ing aircraft profitability. For one thing, valuation put on property and equipment is primarily one of judgment, and depends on which of a number of depreciation standards is utilized.

Retirements of machinery go on constantly, although not fully depreciated on the books. Property completely written off continues to be used.

Most important, technological advances are so far-reaching that they dictate the introduction of the most advanced facilities available. Capital expenditures of this type help make possible more efficient production and improved aircraft types at relatively lower costs to the government.

▶ **Renegotiation to Come**—There can be no doubt that aircraft earnings were very good last year. But as pointed out here a year ago: "Ultimate results will . . . be influenced by the course of contract price redeterminations and subsequent renegotiation. But renegotiations will come two or more years after sales and earnings are recorded for 1954. So adjustments, if found necessary, may have the nature of a delayed reaction."

Since that was written, Grumman Aircraft Engineering Corp. was confronted with a $710,000 renegotiation refund covering 1951. McDonnell Aircraft Corp. has appealed a Chicago Regional Board refund decision for an undisclosed amount.

It now appears probable that renegotiation refunds may be required of other aircraft companies up to and including 1954 results. This is the major qualification tempering the outlook for the aircraft industry at this time.

Sales should be well sustained for 1955 and net earnings, on average, should be of the same measure as last year, not taking into account contract price redetermination and renegotiation.

—Selig Altschul

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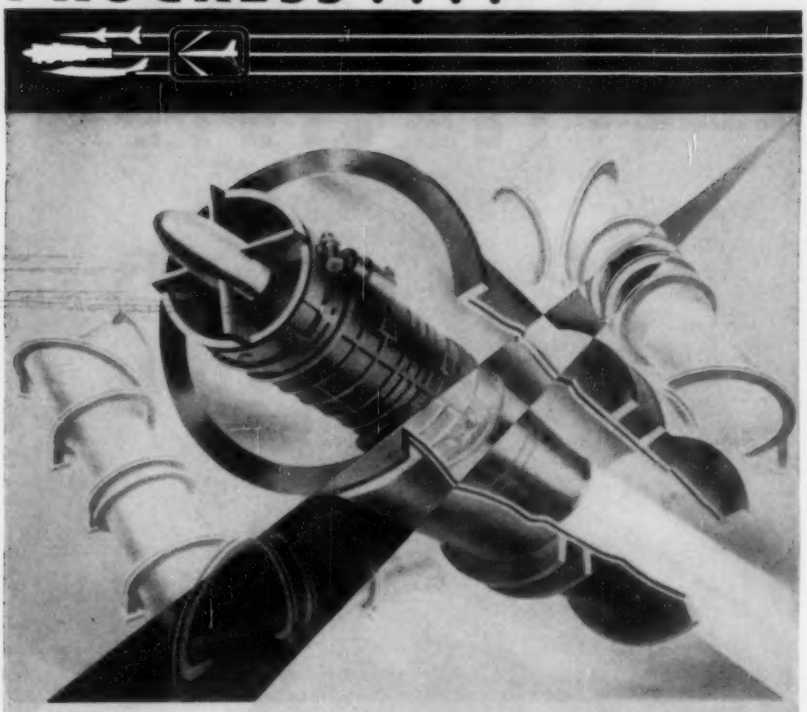

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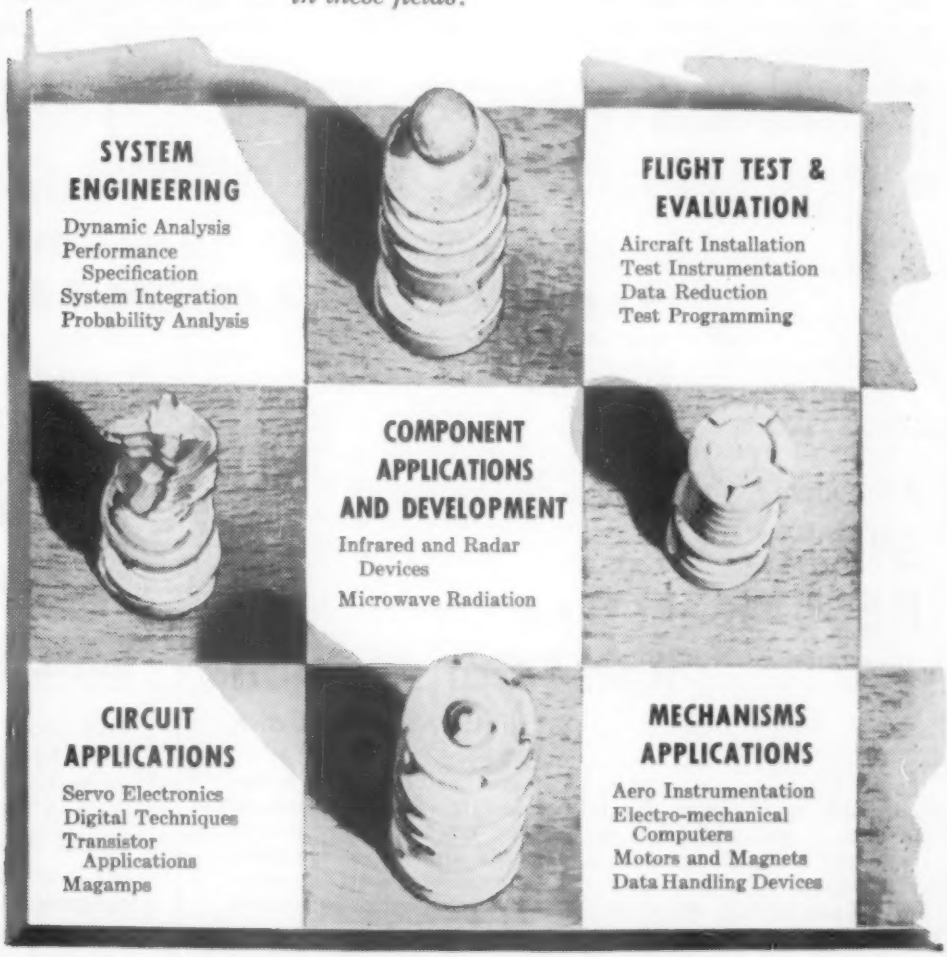

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P-6220, Aviation Week
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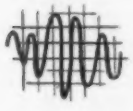

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PATENTS

The Office National d'etudes et de Recherches Aeronautiques, 55 Bd Malesherbes, Paris, France, holder of U.S. Patents n. 2,690,810, dated October 5, 1954 "Rotary blade device for aircraft", n. 2,692,480, dates October 26, 1954 "Supersonic internal circulation combustion chamber, in particular combustion chamber for aircraft jet engines" and n. 2,694,897, dates November 23, 1954 "Turbojet power plant with braking auxiliary jets", should like to deal with constructors in the United States through licensing.

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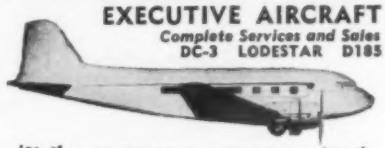

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9	557-5C	Valve
384	564-2A	Oil Separator
52	578-3A	Valve
3	610-2	Valve
8	610-2C	Valve
71	612-3A	Valve
140	612-4A	Valve
4	659-2	Oil Separator
1	659-2A	Oil Separator
214	716-3A	Generator
3	800-1C	Inverter
1	800-1D	Inverter
5	813-4	Valve
3	847-4A	Valve
2	847-8A	Valve
1	1011-2A	Valve
71	1003-4	Generator
8	1181	Valve
3	1181-1	Valve
6	1181-1A	Valve
5	1181-1CE	Valve
1	1182-1	Valve
6	1195-4A	Vibrator
3	1195-4B	Vibrator
16	AN6203-1	Accumulator
41	AN6203-3	Accumulator
50	AN6213-2 (403643-0-1)	Valve
2	AN6214-2 (403644-1)	Valve
9	145795	Valve
34	146102	Valve
4	146166	Valve
2	146300	Valve
21	146575R	Valve
70	401561-2	Valve
27	401856-4	Valve
30	401856-5	Valve
12	403196-0-1	Valve
4	403249-0-1	Accumulator
13	404503	Valve
3	406982	Actuator
1	414920	Valve
1	452057	Valve

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Pieces	Part Number	Description
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3	HC2099-M6	Sequence Valve
24	HC2109	Hyd. Cylinder
9	HC2110	Hyd. Cylinder
3	EE3580	Motor

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54	25432	Flex. control cable
32	50033	Pressure switch
17	92980	Valve
22	92990	Valve
5	90420-2	Valve
10	17589-2	Valve
1	81075	Turbine heat exchanger
2	EI20153-188-183	Pressure switch
4	E180011-1	Water separator
8	90420-2-50	Valve

AEROTEC

20	M101B	Pressure Switch
5	M102	Pressure Switch
20	V301B7	Pressure Relief Valve
349	M826	Pressure Switch
5	P1101W	Flow Indicator
93	4401W	Fuel Float Switch

PESCO

15	1EAR-280BH	Pump
8	1E-621	Pump
21	2E258SA	Pump
32	3V-217-HC	Seperator
2	111001-010-03	Motor
1	121040-065-01	Pump
3	141082-22-01	Booster Pump

AIRBORNE

1	R11M6-3	Actuator
10	R170-M1	Actuator
1	R174-M6-9	Actuator Trim Control
2	R174-M6-10	Actuator Trim Control
1	R174-M6-11	Actuator Trim Control

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Pieces	Part Number	Description
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2	1648K	Actuator
1	164-CUL-1A	Actuator
1	164-DP1	Actuator
4	164-DP4	Actuator
1	164-DP5	Actuator
12	189W	Actuator
161	490-DY	Actuator
159	490-EC	Actuator
14	550-CG	Screw Jack
22	550-DJ	Screw Jack
1	562E	Screw Jack
2	563ER	Screw Jack
1	563-E4	Screw Jack
6	577-P	Screw Jack
8	730AL	Coupling
11	732A	Coupling
40	733A	Coupling
14	740A	Coupling
35	744A	Drive Unit
4	760A	Coupling
38	761A	Coupling
2	830-FM-9835	Indicator
4	989-E-1	Control
13	989-C	Control
1	M8684 (440-AN1)	Actuator
1	M8691 (440-AP1)	Actuator

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144	K702-FG-6D	Plug Valve
34	K702-FG-8D	Plug Valve
14	K1207-8-16	Static Switch
124	1401B	
2	K1440B	Valve
6	K1625B	Cock
59	AN5831-1	Static Switch
40	7201-2	Valve
1	29851	Valve
145	35801-3	Valve

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6	5718-1	Valve
8	12782	Valve

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71	D7818-5.0	Pumps
24	D8157	Pumps
237	9696	Valve
7	9696-2	Valve
4	11145-2	Valve
2	11145-5	Valve
1	12880-2	Valve
10	12880-3	Valve
106	12924-2	Valve
1	12934-2	Valve
11	17381	Valve
4	17837	Valve
4	18028	Valve
8	20448-2	Valve
8	20501-3	Valve
1	21700-3	Valve
1	22407-1	Pump
9	22601-1	Valve
14	23314-3	Valve
77	69221 (1021-5)	Valve
33	18784	Valve

AIR CONDITIONING

Pieces	Part Number	Description
6	83A94	Surface Combustion Heater
2	C97A49	Surface Combustion Heater
7	C97-A28	Surface Combustion Heater
185	921-B	Stewart Warner Heater
9	C050A	Air Engineering Blower
3	A28A8640	Joy Blower
5	AFB129-100	Hoover Blower
18	4582-A-A-6C	Dynamic Air Engineer Blower
358	23010N	Thomas A. Edison Thermostat
10	3094	Barber Colman Thermostat
1	AR5519	Thermostat
10	FYLD2516	Thermostat
35	LD10W	Thermostat
126	17322-2	Fenwal-Thermoswitch
4	184230-0	Fenwal-Thermoswitch
20	18522-0	Fenwal-Thermoswitch
3	17322-1	Fenwal-Thermoswitch
261	1033-4E1	White Rodgers-Heat Control switch
22	A55A00	Surface Combustion Heater Ignition Unit
12	46B361	Vapor Car Heating Temperature Compensator

AIR CONDITIONING

Pieces	Part Number	Description
36	9804B	Vapor Car Heating Control Box
49	715E	Fulton Syphon Temperature Control
1	03C-10	Surface Combustion Heater Ignition Unit
130	PG208AS7	Minn. Honeywell Air Ram Switch
9	PG208-AS1	Minn. Honeywell Air Ram Switch
22	17343-6	Thermoswitch
22	18422-0	Fenwal Thermosat
13	954-A	Thermoswitch
3	PG208-AS13	Air Ram Switch
20	M101B	Aerotec Pressure Switch
5	M102	Aerotec Pressure Switch
349	M826	Aerotec Pressure Switch
9	4510-1	Aerotec-Air Vent
35	SW470544A	Stewart Warner Valve
18	SW472083	Stewart Warner Heat Exchanger
2	G475015	Stewart Warner Valve
1	B1075	Airesearch-Turbine Heat Exchanger
4	17320-12	Fenwal Thermoswitch
4	18423-0	Fenwal Thermoswitch

AIRCRAFT ACCESSORIES

9	014016-S1-16	Disconnect Coupling
166	38QD1800B	Allen Disconnect Coupling
371	5QD1800B	Allen Drop Tank Valve
132	8QD1800B	Allen Drop Tank Valve
47	142-S2-4	Aeroquip Hyd. Coupling
10	9530493	Westinghouse Air Brake Valve
2	820641	Air Brake Valve
3	401473-3	Bendix Valve
3	401856-3	Bendix Valve
111	10-55085-1	Bendix Filter Unit
8	AA37001	Vickers Valve
465	417033	Wright Crankcase Stud Assy.

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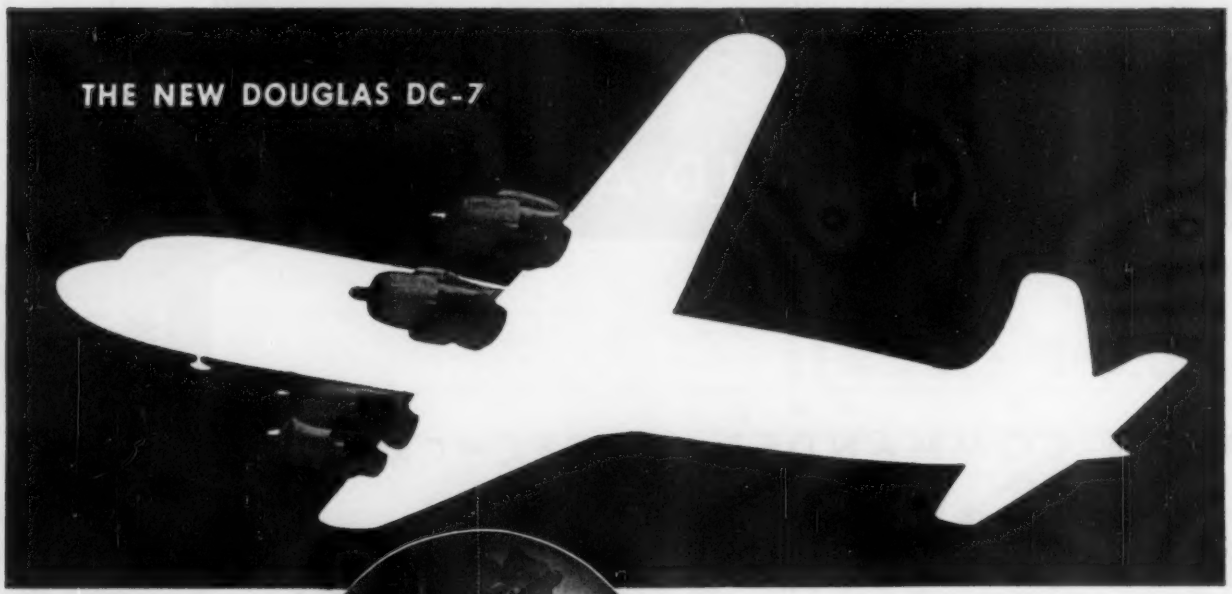

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CHULA VISTA AND RIVERSIDE CALIFORNIA

Summer Air Traffic to Reach New High

Lack of equipment, crews limiting factors in boom; carriers expecting minimum 10% business increase.

By Craig Lewis

This summer—the big season in airline travel—will be the biggest the airlines have ever had.

Capacity will be increased about 10%, and the traffic is still expected to be so heavy that it is estimated that the carriers will have to operate as much as 5% below the traffic potential just because there will not be enough airplanes and crews to handle the crowds on high density routes.

U. S. airlines are in the midst of a substantial boom in traffic that probably will result in a very much improved profit picture this year.

There are numerous unanswered questions involved in assessing the factors behind the boom and the prospects of its holding up. But most observers agree that the increased traffic and an increase in load factors—a key to profits—are going to solve last year's problem of narrowed profit margins.

Predictions for a big summer are based on various signposts. An accurate one is the phenomenal turn first quarter traffic has taken, continuing the trend that started last fall (AW Apr. 18, p. 124). Even if the airlines merely retain gains already made in 1955, the year's business would set records.

'Mass Migrations'

Industry experts, wary because of some uncertainty over just what factors must be considered in making predictions, figure that traffic will increase more than 10% in domestic and international travel. Fairly conservative forecasts are 18.5 billion domestic passenger-miles and 4.2 billion international passenger-miles.

Other signs are seen in industry expansion of services. Pan American World Airways has increased flight frequencies in summer schedules by 32%, and Trans World Airlines has increased system capacity in available seat-miles by 13%. Both are counting on a "mass migration of Americans to Europe," a PAA official says. Both are heavily booked for the season.

New equipment will increase capacity. TWA will complete delivery on an order of 20 Super-G Constellations by midsummer. Both Eastern Air Lines and Pan American will add DC-7Bs to their fleets this year. American Airlines isn't getting any new airplanes in 1955, but has converted DC-6s to increase aircoach capacity 20% this summer.

Pan American, Eastern and National Airlines have a leasing plan for building their fleets during peak traffic seasons. Pan American loans two airplanes to Eastern and two to National during their heavy winter season. In return, PAA gets two airplanes from each of them during its summer peak.

The aircraft going into service this year will be used largely in first class service.

It isn't yet clear how much present first class equipment will be released for conversion to aircoach, but the bulk of them are going to airlines which are aircoach promoters. Conversion is relatively quick and easy, so it is difficult to spot figures very far in advance.

Spending Mood

The domestic trunklines are now operating about 34% of their total services in aircoach, and the share is expected to approach 38% by the end of the year.

International services are about 53% aircoach at present, and will probably go to 60% by year end.

Sales promotion programs are expected to be very effective in the general atmosphere of good times the nation is enjoying. Prominent among them is the variety of installment buying plans for ticket purchases. Pan American alone expects to bring in about $10 million in new business this year with its plan, and other carriers are equally optimistic.

The reasons for all this enthusiasm and all the gains made thus far haven't been developed clearly, mostly because the experts are still somewhat awed by it all.

But the most popular guess, and undoubtedly the closest to the truth, is that business is good. The economy is in remarkably good health and the airline industry is booming along with it.

The national boom is taking place on both production and consumer fronts, and this is the key to the success of airlines.

Present production is extraordinarily high in many items, especially autos and housing, but reports indicate that sales are keeping up with production. People have the money and, perhaps more important, are in the mood to spend it.

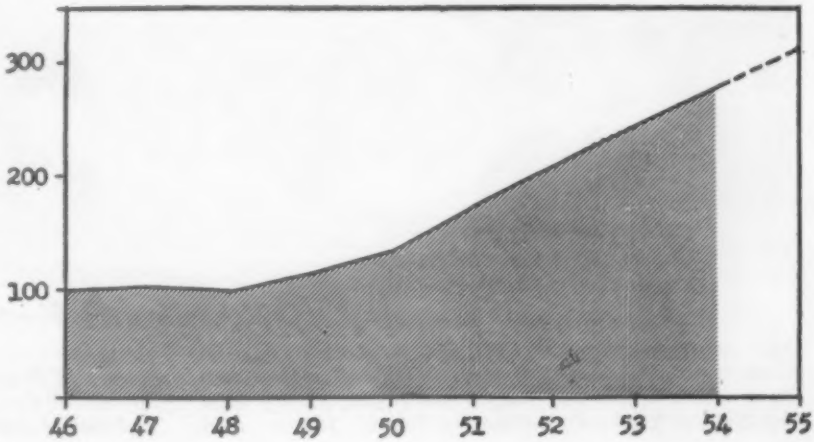
Fears that existed in government circles a month ago that there might be a slump toward the end of the year have disappeared. The Administration now has the feeling that the economy is bound for a substantial period of growth that won't be tied to an inflational spiral.

Load Factor Up

This correlation between the economy and the airline industry is a symptom of increased maturity. During the postwar years, the rate of growth of the

Domestic Trunkline Traffic

(1946 = 100)



industry consistently exceeded that of the gross national product, the standard measure of the economy's yearly accomplishment. But factors which contributed to this—safety, reliability, comfort—have become relatively less important in the growth curve as progress brings them up to modern standards.

As the public comes more and more to regard air travel as just another form of transportation, their ability to pay for it becomes a more vital factor than their feelings about safety or reliability. The key to the airline profit situation lies in load factors, and they are one of the encouraging factors in the boom. There has been a steady downward trend in load factors since 1952. Now, the trend is up. Since late fall load factors have averaged nearly two points above last year (see box).

The airlines are selling a very perishable commodity. If a seat isn't sold on a flight, it disappears as a salable item. Since costs remain fairly rigid whether flights are operated full or empty, the percentage of seats sold, the load factor, is highly important. Once the factor reaches a breakeven point, which varies among carriers, revenues show up with a high percentage of profit.

Last year, airlines were concerned over narrowed profit margins. While revenues rose, profits didn't, and a need for fare increases was discussed.

Charter Review

Since traffic growth has been relatively constant over the years, the cause of fluctuating load factors has, to a large extent, been variations in total capacity. During 1954, the domestic airlines made considerable additions to their fleets. This increased capacity beyond increases in traffic, with a logical decline in load factor. The outstanding fact of the current upward trend is that traffic has taken up the slack in availability so quickly. Equipment bought to provide for future traffic is, to a certain extent, now inadequate to handle present needs.

Domestic Trunkline Load Factors

	1953	1954	1955
Jan.	63.2%	59.8%	61.6%
Feb.	64.3	58.7	60.6
March	66.3	59.2	
April	68.9	62.6	
May	65.8	61.5	
June	71.0	69.7	
July	65.6	66.1	
Aug.	66.4	70.9	
Sept.	65.3	65.6	
Oct.	61.9	63.3	
Nov.	58.1	61.0	
Dec.	59.4	61.6	

Airline confidence in greater future traffic gains is shown by the huge backlogs of orders from both U. S. and foreign carriers held by equipment manufacturers. This month, United increased to 38 its order for DC-6B and DC-7 aircraft for 1956-57 delivery. American, Pan American, TWA and others also have substantial orders.

A recent move taken by the Civil Aeronautics Board gives another indicator of the situation in international travel. The Board is going to review its trans-Atlantic passenger charter policy to see if it needs changing. Under the current policy, Atlantic charters are supposed to be operated by the certificated carriers whenever possible.

On the basis of recent reports, the Board has recognized that while regular business has expanded considerably, charter applications have also increased. The certificated carriers have concentrated on developing single fare traffic and currently have neither the equipment nor the inclination to divert their energies to charter service.

Meanwhile, exemption applications from irregular carriers have increased to take up the slack left by the international flag carriers.

The CAB will hear arguments this week from interested parties and will decide whether a change is required.

CAB Proposes 1955 Airworthiness Agenda

Civil Aeronautics Board is circulating for industry comment a proposed agenda for the annual Airworthiness Review Meeting scheduled for early September.

The proposed agenda consists of 20 major items, all suggested changes in the Civil Air Regulations.

CAB's Bureau of Safety Regulation requests industry comment on the proposed agenda be submitted by July 1. The comments will serve as a basis for preparation of a final agenda which BSR will release Aug. 1. The final agenda may be reduced in size but no new items will be added.

The proposed agenda is made up entirely of proposed changes in the airworthiness regulations submitted by Civil Aeronautics Administration, Aircraft Industries Assn., Air Line Pilots Assn., and the BSR.

They include changes in structural requirements, control surfaces and systems design, powerplant installations and instrument requirements, airspeed indicator markings, position light requirements, fatigue strength requirements, gust load requirements, seats, berths and safety belts, and flight instrument panel arrangement.

Turboprop YC-121F Starts First Takeoff

First turboprop-powered YC-121F built by Lockheed Aircraft Corp. starts to roll down the runway at Burbank on its maiden flight. The new Air Force transport now is going through initial test flights at Lockheed's Burbank and Palmdale facilities. After the builder's trial program is completed, the YC-121F will be flown to Edwards AFB for further tests and crew training. Powered by four Pratt & Whitney T34s, the military version of Lockheed's Super Connie will be a passenger-cargo-hospital plane.

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EAL, Braniff Get Interchange In Settlement of Balboa Case

President Eisenhower and the Civil Aeronautics Board last week ruled in the Balboa case that Eastern Air Lines and Braniff Airways should operate interchange service between New York and South America in order to protect competition among carriers serving Latin America.

The case was finally settled after years of processing and deliberation in which it was shuttled back and forth between the CAB and the White House, reopened, decided twice and now, finally, approved. In the process, attempts were made to effect a merger between Pan American-Grace Airways and Braniff Airways, but they failed.

Provisions

The decision approved by the President in Augusta, Ga., last week is practically the same one which first went to the White House in June 1952.

It provides for:

- **An interchange** between Eastern and Braniff between New York and Balboa, C. Z., via Miami and beyond to South America.
- **Approval** of the through-flight agreement between Panagra and Pan American World Airways providing the two carriers reach an agreement for a New York-Balboa interchange with National Airlines.
- **Proposals** for interchanges between Eastern, Pan American and Panagra be denied.

The basic question involved in the case was which combinations of carriers should be approved for interchange service between the northeastern United States and Balboa, and thus western South America where Panagra and Braniff compete. A number of plans were presented involving National and Eastern between New York and Miami, and Pan American, Panagra and Braniff beyond Miami to the South.

Latin America is the largest overseas market for American flag carriers. Improvement of service between the Northeast, a primary traffic originator, and the South is regarded as important. From the point of view of immediate service benefits to the public, the Board grants that the Eastern-Pan American plan is best.

CAB Reasoning

The determining factor in the decision favoring Braniff and Eastern was the need for strong competition on southern routes. Both Braniff and National are small in comparison with their competitors—Eastern and Panagra-Pan American.

"It is clear," said the Board, "that the Eastern-Pan American-Panagra combination would have an overwhelming competitive advantage over other American flag service both in South America and in the United States. This advantage flows from a variety of factors including the vast discrepancies, in the combine's favor, in the size of the competing carriers, their entrenched position in the market, and the much larger sales organization and budgets available for promotion of their service."

The Board pointed out that one of the reasons for certificating Braniff to South America was to provide competition for the Pan American system. It was found necessary to give Braniff access to the big New York market in order to promote more vigorous competition on the southern routes.

The proposed combinations give Braniff the strongest possible partner on the New York-Miami segment and would give National the strongest partner in Latin America.

▶ **Panagra Suit**—In order to put an interchange into effect, it was necessary to extend Braniff from Havana to Miami with the restriction that Miami can be used only on through-plane flights in an interchange.

The record in the case is held open for 60 days to give the carriers time to submit interchange plans. The Pan American-Panagra through-flight agreement approval is tied to a successful plan with National. The Board noted that Panagra is involved in an antitrust suit with the Justice Department in which the decision could have an effect on approval of the agreement. Thus approval will be granted until 1960 or until 90 days after a final order in the antitrust case.

Eastern and Pan American have proposed various interchange services between New York and the Caribbean area. The Board doesn't approve these, but says it would look with favor on any similar projects National and Pan American might wish to undertake.

ACC Adopts Tacan Compromise

A new common system concept for short range air navigation has been laid down by the Air Coordinating Committee.

The concept calls for a civil-military non-tactical system (VOR/DME), as well as basic tactical system (Tacan), with ultimate adoption of Tacan for use in the eventual common system. Under this program, ACC estimates, VOR will be continued until 1965 and that DME will be continued until 1960.

The ACC decision follows the original decision made by Air Navigation and Development Board except that it agrees to seek retention of DME until 1960. ANDB recommended ending DME this year.

The ACC ruling carries out the agreement reached between Department of Defense and Department of Commerce and reported exclusively in Aviation Week (Apr. 11, p. 12).

The unknown factor in carrying out this ACC program is Congress. Congress will have the last word on whether it will support any further implementation of DME through its fund appropriating powers. The ANDB had proposed limiting use of civil DME facilities to experimental purposes with no guarantee of continued DME service beyond June 30, 1955. ACC has proposed another five years of DME subject to congressional appropriations.

To prevent future disputes, ACC said that mandatory consultation will be required.

The ACC report states: "The agencies of the government responsible for the implementation or operation of any

Transport Report Favors Railroads

The long discussed and disputed report of the Cabinet Committee on Transportation was handed to the President last week in a form much altered from earlier reported versions.

The report has little application to aviation. It is concerned for the most part with freight and is generally conceded to be favorable to the railroads. The whole philosophy involved is that transportation regulation is based on a monopoly situation which no longer exists. The committee recommends that regulation, especially of the railroads, be relaxed to allow carriers greater competitive latitude.

In order to become really effective, the report will require implementing legislation. There is practically no chance of getting anything through Congress this late in the session, and passage next year may be difficult. The trucking industry doesn't like the report, and it is a powerful political force.

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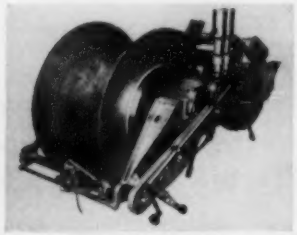

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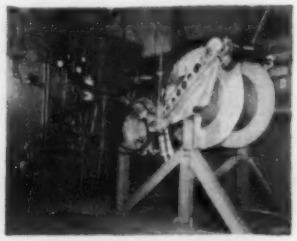

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phase or phases of the present or future common system program will consult with other interested agencies through ACC in the discharge of these responsibilities. Any implementation of DME will be carried out only in proper priority relationship to the other needed improvements in the system."

ACC sets out four major steps for the implementation and development of short distance air navigation system.

• **Interim military tactical program.** The military is ordered to proceed with implementing the minimum amount of Tacan necessary to meet military tactical requirements. Such installations are prohibited, however, from interfering with the transponder beacons or DME.

• **Common system development program.** ANDB is directed to plan and follow the completed development of Tacan for possible common system use. ACC expects to be kept closely advised in order that it can consider the problem of adoption of Tacan as the common system element as soon as technical progress warrants.

• **Common system program.** CAA is to continue with the present VOR/DME system until some succeeding common system has been adopted and installed. It was noted that during the transition period, when a succeeding common system is being installed, priorities in frequencies or other areas of conflict are to be given to the succeeding system.

• **International planning.** ACC proposes that the members of International Civil Aviation Organization that they consider substituting Tacan for VOR/DME once Tacan has been made the final choice.

TWA Orders 24 Super Connie 1649s

Howard Hughes has ordered 24 of Lockheed Aircraft Corp.'s piston-engine 1649 Super Constellations for Trans World Airlines. Cost of the new fleet will total $70 million. First deliveries are scheduled for early 1957.

Hughes was interested in Lockheed's turboprop-powered Super Connie proposal but believed engine development was not far enough along to warrant a contract. He also looked over Boeing Airplane Co.'s 707 jet transport.

Powered by 3,400-hp. Wright Turbo Compound R3350-EA2s (AW Apr. 4, p. 15), the 1649s will have a range of more than 6,500 miles. Cruising speed will exceed 350 mph.

Wings will be patterned after Lockheed's turboprop C-130 cargo transport and will have the same airfoil. They will be 27 feet longer and 200 square feet greater in area than previous Constellations, allowing engines to be placed farther from the cabin.

Takeoff weight is 156,000 lb.

Airlines File Salaries, Bonuses Paid to Executives During 1954

Scheduled airline payments to officers and directors for salaries, bonuses and other compensation during 1954 have been reported to the Civil Aeronautics Board as follows:

American Airlines, Inc. C. R. Smith, president and director, $73,185 salary; W. J. Hogan, senior vice president—finance, $47,707 salary; C. W. Jacob, senior vice president and secretary, $47,707 salary; O. M. Mosier, senior vice president—operations and director, $47,707 salary; C. R. Speers, senior vice president—sales, $32,487; G. J. Brandewiede, vice president, $31,714 salary; R. E. S. Deichler, vice president, $39,032 salary; L. G. Fritz, vice president, $36,593 salary; L. E. Glasgow, vice president and controller, $23,562 salary; G. K. Griffin, vice president, $26,418 salary; W. H. Johnson, Jr., vice president, $26,418 salary; William Littlewood, vice president, $26,835 salary; R. W. D. Smith, vice president, $28,941 salary; G. C. Van Nostrand, vice president (elected May 19) $16,338 salary; Marvin Whitlock, vice president, $23,562 salary; P. G. Larle, treasurer, $21,706 salary; M. G. Beard, assistant vice president (elected March 1), $22,788 salary; T. L. Boyd, assistant vice president, $25,000 salary; J. J. Casey, assistant vice president (elected May 19), $14,678 salary; W. C. Lawrence, assistant vice president, (elected May 19), $18,243 salary; A. D. Lewis, assistant vice president (elected May 19), $17,322 salary; G. E. Markt, assistant vice president, $13,917 salary.

W. L. McMillen, assistant vice president, assistant treasurer and assistant secretary, $19,667 salary; M. L. Rinehart, assistant vice president and assistant treasurer, $22,083 salary; E. O. Schroeder, assistant vice president, $22,083 salary; M. W. Shipley, assistant vice president (elected Sept. 15), $14,923 salary; V. J. Long, assistant controller and assistant secretary, $19,667 salary; C. N. Oursler, assistant controller (elected March 1), $18,077 salary; A. A. Paradis, assistant secretary, $12,833 salary; A. R. Bone, Jr., regional vice president, $22,083 salary; W. N. Bump, regional vice president, $22,083 salary; T. P. Gould, regional vice president, $22,083 salary; M. D. Miller, regional vice president, $22,083 salary.

Harold T. Ames, director, $900 directors fee; J. S. Aston, director, $800 directors fees; Harry E. Benedict, director, $900 directors fee; James Bruce, director, $800 directors fee; E. H. Butler, director, $300 directors fee; Amon G. Carter, director, $300 directors fee; C. S. Choston, director, $900 directors fee; Thomas M. Conroy, director, $1,100 directors fee; Silliman Evans, director, $400 directors fee; John W. Farley, director, $700 directors fee; Charles T. Fisher, Jr., director, $500 directors fee; James A. Jackson, director, $800 directors fee; A. N. Kemp, director, $400 directors fee; Robert W. Miller, director, $500 directors fee; Edgar M. Queeny, director, $400 directors fee.

Persons other than directors, officers and employes receiving compensation for personal services in excess of $10,000 in 1954: Alvord and Alvord, legal counsel, $17,350; Coston and Frankfurt, architects and engineers, $17,201; Covington and Burling, legal counsel, $140,300; Debevoise, Plimpton and McLean, legal counsel, $207,000; Schofield and Weed, architects, $16,158; and Arthur Young and Co., public accountants, $38,000.

Alaska Airlines, Inc. Nelson David, president, general manager and director, $24,999.68 salary and $200 directors fee; Frank C. LaGrange, director, no salary and $150 directors fee; K. M. Lesh, director, no salary and $100 directors fee; R. W. Marshall, director, no salary and $100 directors fee; Robert J. Norris, director and secretary-treasurer (elected April 10), $8,400 salary and $100 directors fee; Roland P. Place, director (elected April 10), no salary and $50 directors fee; Homer W. Robinson, chairman, board of directors, no salary and $200 directors fee; Paul C. Taylor, director (elected April 10), no salary and no fee; Ross A. Urquhart, director, no salary and $100 directors fee; Ralph W. Starkey, vice president, $11,200 salary; Donald L. Ingalls, assistant secretary-treasurer, $7,800 salary; Juliana D. Wilson, assistant secretary-treasurer (elected April 10), no salary and no directors fee, $1,300 retainer as legal counsel in Alaska.

Pogue and Neal, legal services, $43,435.99; Allen, Hilen, Fronde, DeGarmo and Leedy, general legal counsel, $18,128.10; The Burke Co., advertising services, $67,913.85, and Thomas Anderson Transportation Co., cargo handling services, $30,000.

Pan American-Grace Airways, Inc. Andrew B. Shea, president and director, no salary and no directors fee; Erwin Balluder, vice president and director, no salary and no directors fee; Douglas Campbell, vice president and general manager, $24,000 salary and $7,000 bonus and indirect compensation; T. J. Kirkland, vice president, $21,000 salary and $4,000 bonus; K. A. Lawder, vice president and comptroller, $21,000 salary and $5,000 bonus; E. G. Bern, vice president, $18,000 salary and $3,000 bonus; G. S. Collins, assistant vice president, $12,000 salary and $1,200 bonus; W. F. Cogswell, secretary, no salary; H. Preston Morris, assistant secretary, no salary; A. J. Phelan, assistant comptroller, $12,000 salary, and $1,200 bonus; W. F. Lewis, assistant treasurer, $11,000 salary and $775 bonus; and E. E. Spencer, assistant treasurer, $10,500 salary and $775 bonus.

Covington and Burling, legal services, $11,000; Burns, Currie, Rich and Rice, legal services, $12,000; White and Case, legal services, $17,500; and Price Waterhouse and Co., accounting services, $16,800.

Caribbean-Atlantic Airlines, Inc. Dionisio Trigo, president, $16,500 salary; Berriguo Trigo, vice president, $6,500 salary; Jose M. Sierra, vice president—operations, $13,000 salary; L. A. Lockhart, treasurer, $8,600 salary; Adolfo Valdes, secretary, no salary; and Henry G. Molina, assistant secretary, no salary.

Colonial Airlines, Inc. Branch T. Dykes, president and director, $28,993 salary and $2,849 accrual of proposed retirement benefit plan; Thomas J. Dennison, vice president, $17,533 salary and $1,260 accrual of proposed retirement benefit plan; James E. Reinke, vice president—traffic and sales (elected May 16), $13,053 salary (includes salary before election as officer) and $494 accrual of proposed retirement benefit plan; Norman D. MacDonald, treasurer, $11,333 salary and $383 accrual of proposed retirement benefit plans; Thomas A. Campo, assistant treasurer, $8,167 salary and $259 accrual of proposed retirement benefit plan.

L. Orville Cameron, vice president and secretary, $17,333 salary and $785 accrual of proposed retirement benefit plan; Daniel S. Dunn, assistant secretary, $7,267 salary; Robert H. Hernstein, vice president—traffic (resigned Sept. 15, 1953), $583 severance pay; Carl W. Rach, vice president—operations (elected May 16), $18,753 salary (includes salary before election as officer), and $1,284 accrual of proposed retirement benefit plan; John J. Murphy, director and chairman, executive committee, $11,000 salary and $500 accrual of proposed retirement benefit plan; Albert Green, director (elected May 16), no salary and $500 directors fee; Edmond M. Hanrahan, director, no salary and $1,800 directors fees; Francis Hartley, Jr., no salary and $1,700 directors fee; A. Charles Schwartz, director, no salary and $1,600 directors fee; Joseph V. Shields, director, no salary and $1,800 directors fee.

Sullivan, Donovan, Heenehan and Han-

IATA Meeting

Chief executives of 72 member airlines of the International Air Transport Assn. will participate in the eleventh annual General Meeting Oct. 17-21 in New York at the Waldorf-Astoria Hotel.

These airlines fly the flags of about 50 different countries and account for more than 85% of the world air traffic outside of Russia and Red China.

This is the first assembly to be held in New York since IATA was founded ten years ago. U. S. flag carriers will be hosts at the sessions.

Juan Trippe, president of Pan American World Airways, will take office as president of IATA at the opening session. He succeeds Max Hymans, president of Air France.

rahan, legal services, $30,000.

Continental Air Lines, Inc. Robert F. Six, president and director, $35,000 salary; Joseph A. Uhl, vice president, treasurer and director, $17,000 salary; C. C. West, Jr., vice president and director, $19,500 salary; O. R. Hauter, vice president—operations, maintenance, and engineering, $20,500 salary; Lynn H. Dennis, vice president—flight service, $11,500 salary; Stanley O. Halberg, vice president—traffic and sales, $12,000 salary; S. B. Redmond, secretary, $11,000 salary; G. J. M. Kelly, assistant secretary, $7,114 salary.

C. Edward Leasure, legal services, $22,000; and Holland and Hart, legal services, $17,000.

Delta Air Lines, Inc. C. E. Woolman, president and general manager and director, $48,000 salary; Laigh C. Parker, vice president-traffic and sales, $25,000 salary; Charles H. Dolson, vice president-operations, $24,000 salary; Todd G. Cole, vice president-finance and assistant secretary, $18,666.68 salary; R. S. Maurer, vice president-legal, $17,333.36 salary; W. T. Beebe, vice president-personnel (elected May, 1954), $15,800 salary; Erle Cocke, Jr., vice president-state relations (elected October 1954), $15,800 salary; T. M. Miller, assistant vice president-traffic and sales, $15,000 salary; W. T. Arthur, assistant vice president-operations, $19,500 salary; Carl H. McHenry, secretary, $1,200 salary; Travis Oliver, treasurer, $1,200 salary; Catherine FitzGerald, assistant treasurer, $5,700 salary; R. W. Freeman, chairman of the board, $241.76 salary; and Carleton Putman, director, $7,993.69 salary.

Pogue and Neal, legal services, $33,830; Arthur Anderson and Co., auditing, tax and special services, $15,725; Iazo Y. Cubas, legal services, $10,200.

The Flying Tiger Line, Inc. Robert W. Prescott, president and director, $34,166 salary; George T. Cussen, vice president, $12,489 salary; W. E. Bartling, vice president, $16,600 salary; Ralph B. Stump, assistant secretary-treasurer, $11,300 salary; Fred Benninger, secretary-treasurer, $20,166 salary; T. J. Sullivan, director, $1,125 salary and $600 directors fee; James E. Davidson, director, no salary and $300 directors fee; Samuel B. Mosher, chairman of the board, no salary and $600 directors fee; Norman L. Meyers, director and assistant secretary, no salary; Houston Rehrig, director, $1,125 salary and $600 directors fee; Robert L. Smith, director, no salary, and $600 directors fee; William Zeckendorf, director, no salary and no fee; Lewis G. Burwell, Jr., vice president, $17,833 salary.

Meyers and Batzell, legal counsel, $48,000.

Riddle Airlines, Inc. John Paul Riddle, president and director, $9,269 salary; Peter T. Craven, secretary-treasurer, $8,199 salary; Charles L. Hood, vice president-sales, $9,000 salary; Harry T. Weaver, regional vice president, $7,800 salary; William B. Thompson, Jr., regional vice president, $500 salary; Orlando Torres, regional vice president, $9,600 salary; Jane B. Ramsey, assistant secretary, $4,100 salary; and Philip A. Mann, director, $8,042 salary.

Central Airlines, Inc. Keith Kahle, president and director, $12,000 salary and $25 directors fee; F. E. Howe, executive vice president and director, $12,000 salary and $25 directors fee; Luther Hudson, secretary, no salary; Alicia H. Pritchett, assistant secretary, $4,292.50 salary; John L. Blackwell, vice president-operations (elected May 14), $9,600 salary.

Pogue and Neal, legal services, $11,033.21.

Frontier Airlines, Inc. H. S. Darr, chairman, executive committee, $7,000 salary; C. A. Myhre, president, $14,770 salary; J. D. Lindsay, vice president-traffic and sales, $8,950 salary; E. N. Levin, secretary, no salary; L. P. Blatter, treasurer, $8,468 salary; Irene Moltzan, assistant secretary, $3,780 salary; and E. W. Sexton, Jr., assistant treasurer, $6,150 salary.

Helicopter Air Service, Inc. T. H. Reidy, president treasurer and director, $12,000 salary and $4,000 bonus and indirect compensation; C. W. Moore, vice president, $9,600 salary and $3,000 bonus; C. E. Cessna, secretary and director, $3,600 salary; R. B. Kiel, assistant secretary-treasurer, $7,200 salary.

New York Airways, Inc. Robert L. Cummings, Jr., president and director, $18,275 salary; Horace Brock, vice president (elected Nov. 1), $2,000 salary; William W. Hogan, treasurer, $9,500 salary; Marshall Skadden, secretary, no salary; Glen B. Eastburn, assistant to president and assistant treasurer, $9,000 salary; and John L. Senior, Jr., chairman of the board of directors (resigned April 5), $150 salary.

Skadden, Arps and Slate, legal services, $44,250.

Lake Central Airlines, Inc. R. B. Stewart, president and director, $5,200 salary; Harry V. Wade, trustee, $2,800 indirect compensation; William H. Kreig, secretary and director, no salary and $1,400 bonus and indirect compensation; Cecil A. Berry, director, no salary and $650 bonus; J. D. Peterson, director, no salary and $700 bonus; L. W. Hartman, vice president and treasurer, $10,169 salary; R. W. Clifford, vice president-operations, $11,549 salary; D. S. Getchell, vice president-traffic, $8,450 salary; and J. L. Cory, assistant treasurer, $7,110 salary.

Albert F. Grisard, legal services, $11,095.

CAB ORDERS

(April 7 to April 13)

GRANTED:

Oakland, Calif., Chamber of Commerce leave to intervene in the Air Freight Renewal Case.

APPROVED:

Control and interlocking relationships involving Lifschultz Air Freight, Lifschultz Fast Freight, Lifschultz Terminal Co., Sidney B. Lifschultz, Ida Lifschultz, Bernice Brown, Rose Grossman, Nora Bergman and the estate of S. E. Lifschultz, with certain provisions.

Interlocking relationships between John S. Graham and Slick Airways. Graham is a director of Slick and of Simmonds Aerocessories.

Certain resolutions between various carriers adopted by the International Air Transport Assn. relating to conditions on tourist-class and mixed-class aircraft.

ORDERED:

Application of the City of Staunton, Va., be consolidated with the proceeding involving extension of a Piedmont Aviation route to Washington, D. C.

Extension of the effective date of the final order in the West Coast-Hawaii Case to May 25, 1955 to allow time for reconsideration.

Extension of the effective date of the final order in the Trans-Pacific Certificate Renewal Case to May 25, 1955 to allow time for reconsideration.

DISMISSED:

Application of Interior Airways for extension of a temporary exemption, by request of the carrier.

Application of County Court of Wood County, W. Va., City of Marietta, Ohio and the Marietta Chamber of Commerce for extension of certain Piedmont Aviation services, since the extension has been accomplished in another proceeding.

Appeals Court Studies Pilot Immunity Case

Question of Fifth Amendment immunity granted to witnesses by the Civil Aeronautics Act has moved toward decision, with presentation of arguments to the U. S. Court of Appeals by parties to the dispute.

The dispute arose when the Civil Aeronautics Board turned down a Civil Aeronautics Administration request for suspension of the licenses of two United Air Line pilots. The pilots were involved in the collision of UAL and American Airlines Convairs near Chicago in August 1953.

During the accident investigation, they were granted immunity specified in the Civil Aeronautics Act. The CAA subsequently asked the CAB to suspend the pilot's licenses.

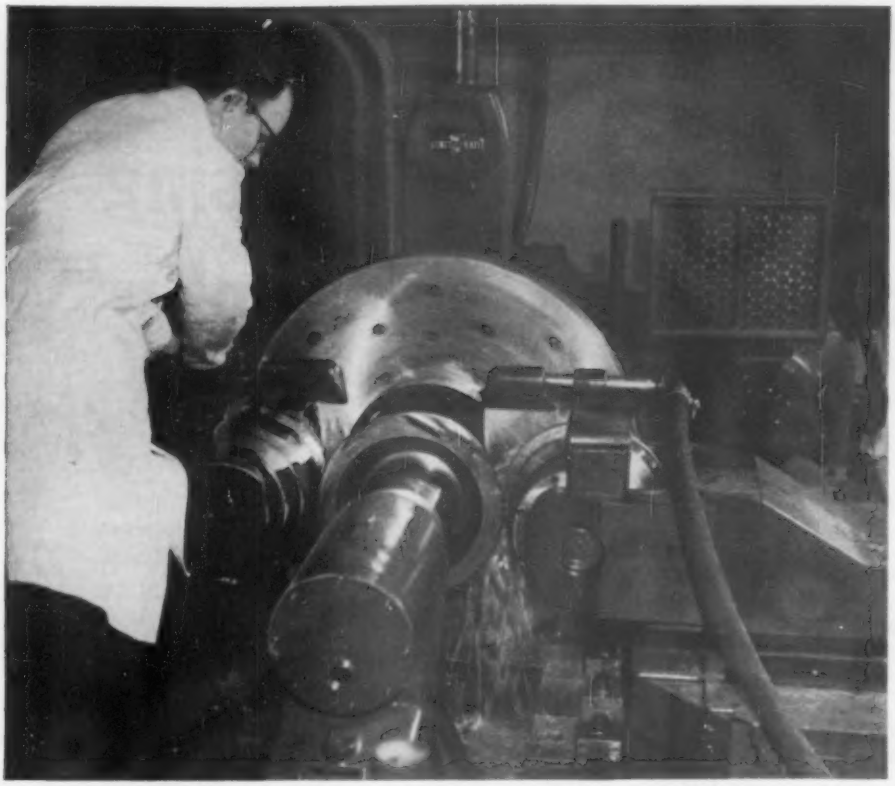
▶**CAB Views**—The Board turned the request down on the grounds that the CAA was trying to punish the pilots and they are protected from such action under the act. CAA asked the appeals court to review CAB's action.

CAB argues that Civil Aeronautics Administrator has no business challenging findings of Board, since he is a prosecutor and his duties in suspension and revocation proceedings are over when he has presented his case.

▶**Public Responsibility**—The Board also holds that the action asked by the CAA would be punishment rather than remedy and such action is barred by the immunity granted in the investigation.

The CAA argues that the Administrator does have the necessary status to pursue the matter. This status, says CAA, flows from the actions of government reorganization measures and from broad safety regulatory duties.

On immunity, the CAA says the action it wants to take is aimed at protecting the public and is remedial and therefore not affected by the immunity guarantee.



Opposed heavy-duty steel rollers cold-flow tough materials onto a spinning mandrel

New Solar spinning technique cuts costs!

Hydrospin turned out the cone with integral flange from the simple disc at left

THE FIRST HYDROSPIN machine in the United States is now in use at Solar. Built for the company by Cincinnati Milling Machine Co., this remarkable new production tool easily squeezes cold alloy steels into hard-to-form shapes. Even better news is this: the Hydrospin can cut production costs in half on many aircraft and industrial components!

Semi-automatic in operation, the Hyrdospin takes a blank metal disc and applies the pressure of heavy-duty rollers. As the rollers advance, the material is smoothly forced onto a rotating mandrel. Difficult contours in cones and cylinders are easily obtained with the Hydrospin. Parts containing elements of varying thickness, such as walls, flanges and support areas, can be made in a single operation. Both material and labor costs are sharply reduced by this advanced metal-working technique.

This new machine typifies a basic Solar principle—use of the best and latest processes and equipment to turn out top quality metal products. And every Solar customer receives still another "plus"—the *integrity factor* inherent in all of Solar's work. Why not find out more, today, about the Solar skills that can help your business?

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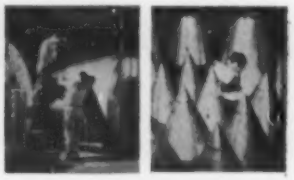
When heat, corrosion or difficult specifications are problems, Solar can help you solve them. Solar specializes in the manufacture of precision products from alloys and special metals for severe service. Solar's experience since 1927 is unduplicated in this field.



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Gas Turbines. *Solar "Mars" 50 hp engines for auxiliary generator sets, ground carts, portable fire pumps; Solar "Jupiter" 500 hp engines in variable and constant speed models.*

Bellows. *"Sola-Flex"® bellows and expansion joints in many designs from ½ in up to the world's largest, 28 ft in diameter.*

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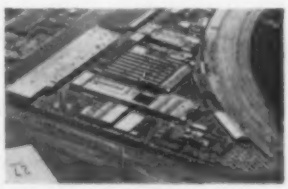

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"The World's Most Promising Technological Revolution"

The Electronics industry is truly "the world's most promising technological revolution."

Even though it grew phenomenally during World War II, Electronics really came into its own following the war. By 1948, it had become a $3,000,000,000 business, and was rapidly becoming a major industry.

Today, Electronics is a $9,000,000,000 industry—counting television, radio, military electronics, commercial electronics, broadcasting, and related areas. There is every indication that by 1960 it will be a $15 billion dollar industry and $20 billion by 1964. And it will keep right on climbing.

No other major industry will grow that fast in the next decade.

The Armed Services, by far the largest customers of electronic products, spent an estimated $145,000,000 in 1948 for electronic equipment for communications, navigation, gunnery systems, etc. Today, government electronic purchases amount to $2,300,000,000 (or 6.3 per cent) of its total defense expenditures. Within the decade, this may increase to 10 per cent of total government buying as the Armed Services become increasingly electronified. It is estimated that government electronic purchases will amount to over $4,000,000,000 by 1964.

The potential volume in commercial and industrial electronics is unprecedented, especially in the field of computers, the heart of data processing, and "automation." Sales of electronic equipment to commerce and industry amounted to $1,000,000,000 in 1954, and the surface was barely scratched. This figure will more than double within the next ten years, for this area of electronics has a future limited only by one's imagination.

The future of Electronics has no horizon. Many of the nearly 2,000 scientists and engineers throughout Sylvania are working on Electronics, constantly finding new and better ways to put Electronics to work. *They are keeping an eye to the future—assuring constant progress in the years ahead* . . . "the world's most promising technological revolution."

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AVIATION WEEK—APRIL 25, 1955

AEROPRODUCTS ALLISON DIV., GENERAL MOTORS CORP. 93
Agency—Campbell-Ewald Company
AIRCRAFT MARINE PRODUCTS, INC. 48
Agency—Renner Corporation
ALL AMERICAN ENGINEERING CO. 116
Agency—Gaynor & Co., Inc.
AMERICAN NON-GRAN BRONZE COMPANY 92
Agency—Norman P. Hewitt Adv.
APPLIED SCIENCE CORPORATION OF PRINCETON 8
Agency—Paul M. Healy Adv. Service
ARO EQUIPMENT CORP, THE 45
Agency—Beeson-Reichert, Inc.
ATLAS PRECISION PRODUCTS CO. 28
Agency—A. E. Aldridge Associates
AUSTENAL LABORATORIES, INC. (MICROCAST DIVISION) 41
Agency—Gaynor & Company, Inc.

B. H. AIRCRAFT CO., INC. 82
Agency—Harold Marshall Adv. Co., Inc.
BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. ..... Third Cover
Agency—MacManus, John & Adams, Inc.
BRIDGEPORT THERMOSTAT DIV., ROBERT-SHAW-FULTON CONTROLS CO. 89
Agency—Arndt-Preston-Chapin-Lamb & Keen, Inc.
BURROUGHS CORPORATION 66
Agency—Campbell-Ewald Company

CESSNA AIRCRAFT COMPANY 115
Agency—Gardner Advertising Co.
CHAMPION SPARK PLUG CO. 71
Agency—MacManus, John & Adams, Inc.
CLARY CORPORATION 93
Agency—Erwin, Wasey & Company, Ltd.
CLEVELAND PNEUMATIC TOOL CO. 68
Agency—Meldrum & Fewsmith, Inc.
CLIFTON PRECISION PRODUCTS CO., INC. 60
Agency—Ivey Advertising Company
CONVAIR A DIVISION OF GENERAL DYNAMICS CORP. 19
Agency—Buchanan & Company, Inc.
CONVAIR A DIVISION OF GENERAL DYNAMICS CORP. 96
Agency—Thomas L. Yates Adv. Agency
CROSLEY GOVERNMENT PRODUCTS DIV., AVCO MFG. CORP. 32
Agency—The Ralph H. Jones Co.
CURTISS WRIGHT CORP. 29
Agency—Burke Dowling Adams, Inc.

DAGE ELECTRIC CO., INC. 23
Agency—Jim Bradford Adv.

EASTERN INDUSTRIES, INC. 50
Agency—Reunsen Adv. Agency, Inc.
ECLIPSE-PIONEER DIV., BENDIX AVIATION CORP. 61
Agency—MacManus, John & Adams, Inc.
ELASTIC STOP NUT CORP. OF AMERICA 23
Agency—G. M. Basford Company
ELECTRO MECHANICAL RESEARCH, INC. 78
Agency—Moore & Company, Inc.
ENJAY COMPANY, INC. (BUTYL) 38-39
Agency—McCann-Erickson, Inc.

FAFNIR BEARING CO., THE 3
Agency—Horton-Noyes Co.
FAIRCHILD ENGINE & AIRPLANE CORP. 43-60-78
Agency—Gaynor & Company, Inc.
FULTON SYLPHON DIV., ROBERTSHAW-FULTON CONTROLS CO. 89
Agency—Arndt-Preston-Chapin, Lamb & Keen, Inc.

GENERAL ELECTRIC COMPANY 65-86-87
Agency—G. M. Basford Company
GENERAL LABORATORY ASSOCIATES, INC. 74
Agency—Riger & Sheehy Advertising
GOODYEAR TIRE & RUBBER CO., INC. ..... Front Cover
Agency—Kudner Agency, Inc.
GREENLEAF MFG. COMPANY, THE 77
Agency—Oakleigh R. French & Assoc.

JOHNS-MANVILLE PRODUCTS 113
Agency—J. Walter Thompson Co.

LEAR, INC. (LEAR-ROMEC DIV.) 20
Agency—Buchanan & Co., Inc.
LINK AVIATION, INC. 34
Agency—Gaynor & Co., Inc.
LOCKHEED AIRCRAFT CORP. 64
Agency—Hal Stebbins Adv.
LOCKHEED AIRCRAFT CORP. 65
Agency—Donahue & Coe, Inc.
LORAL ELECTRONICS CORP. 51
Agency—Richard & Gunther, Inc.
LOUD MACHINE WORKS, INC., H. W. 59
Agency—Walter C. Davison Co.

MALLORY—SHARON TITANIUM CORP. 24
Agency—The Griswold-Eshleman Co.
MANNING, MAXWELL & MOORE, INC. (AIRCRAFT PRODUCTS DIV.) 86
Agency—Fuller & Smith & Ross, Inc.
MARMAN PRODUCTS COMPANY, INC. 10
Agency—West Marquis, Inc.
McDONNELL AIRCRAFT CORP. 84

NATIONAL AERONAUTICAL CORP. 8
Agency—Davis, Parsons & Strohmeier, Inc.
NORTHROP AIRCRAFT, INC. 121
Agency—West-Marquis, Inc.
NORTH AMERICAN AVIATION, INC. 5
Agency—Batten, Barton, Durstine & Osborn, Inc.

ORCHARD INDUSTRIES INC., ACTIONFLEX DIV 94
Agency—Bozell & Jacobs, Inc.
OSTER MFG. CO., JOHN 30
Agency—Burton Browne Advertising

PAK RAPID INC. 48
Agency—John B. Ferguson Jr., Adv.

RADIO CORP. OF AMERICA (ENGINEERING PRODUCTS DIV.) 25
Agency—Al Paul Lefton Co., Inc.
RESIN INDUSTRIES, INC. 8
Agency—Taggart & Young Adv.
REYNOLDS METALS COMPANY ..... Fourth Cover
Agency—Clinton E. Frank, Inc.
RHEEM MFG. COMPANY, GOVT. PRODUCTS DIV 37
Agency—Campbell-Ewald Co.
ROBINSON CO., RALPH C. 92
Agency—Chapin-Damm Adv.
ROHN & HAAS CO. 40
Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc.
ROHR AIRCRAFT CORPORATION 110
Agency—Barnes Chase Company

SARGENT ENGINEERING CORP. 83
Agency—Darwin H. Clark Co. Adv.
SCHULTZ TOOL & MANUFACTURING CO. 22
SCOVILL MANUFACTURING CO. (AIRCRAFT FASTENER DIV.) 27
Agency—Needham, Louis and Brorby, Inc.
SEARCHLIGHT SECTION 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109
SERVICE STEEL DIV., VAN PELT CORP. 121
Agency—Claude E. Whipple Adv.
SINCLAIR REFINING CO. 62-63
Agency—Morey, Humm & Johnstone, Inc.
SKYLINE PRODUCTS, INC. 48
Agency—Triton Advertising
SOLAR AIRCRAFT COMPANY 119
Agency—The Phillips Ramsey Co. Adv.
STEEL PRODUCTS ENGINEERING CO. 82
Agency—Geyer Advertising, Inc.
STEWART WARNER CORP. (ELECTRIC DIV.) 91
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SYLVANIA ELECTRIC PRODUCTS, INC. 120
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Agency—John Gerber & Co., Adv.
TIMKEN ROLLER BEARING CO., THE 56
Agency—Batten, Barton, Durstine & Osborn, Inc.
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Agency—Brisacher, Wheeler & Staff

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Agency—Mogge-Privett, Inc.
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Agency—Byron H. Brown and Staff

ZEPHYR MANUFACTURING CO., INC. 58
Agency—The Perrett Co. Adv.

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Positions Wanted 102
SPECIAL SERVICES
To The Industry 106
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A Good Start

During the last year the Civil Aeronautics Board reached a low ebb in its history. Its quasi-judicial position, bi-partisan role and legal authority were only dimly understood by the White House. Its authority was undermined by the Commerce Department and its own leadership provided no positive course to offset an aimless drift.

Under its new chairman, Ross Rizley, a former Oklahoma congressman and Post Office Department solicitor who was drafted by the Republican National Committee to take this important post, there are signs that a reversal of form is in progress. Rizley has restored the bi-partisan aura of the Board by abolishing majority party pre-decision caucuses that led to standard 3- to -2, strictly political decisions. He also approved the appointment of Democrat Joseph Adams as vice chairman, a move that restored another Board bi-partisan tradition. Adams, who is both a jet and helicopter pilot, is the only Board member with practical aviation experience and should provide wise counsel in this post.

Rizley has also spent time expounding the Board's position and authority to the White House staff. He is determined that the Board should regain its quasi-judicial status and not be kicked around as a political football. We doubt if there will be any more fiascos like the Pacific Route Case during Mr. Rizley's chairmanship. In addition, he is making a start on finding methods to speed the Board's interminably slow processes and clean up the backlog of cases that is a heavy millstone on economic progress of civil aviation.

Any CAB chairman is bound to travel a rocky road with plenty of possible pitfalls. Mr. Rizley would be hardly human if he avoided any mistakes. But he has pulled the Board out of its doldrums and is off to a good start.

Is Aviation Necessary?

The fact that aircraft manufacturing has surpassed the automobile industry in employment, payrolls and gross value of product during 1954 has stirred a sour note from the Detroit News in the motor capital. "It is disconcerting," the News says, "to have the auto industry thus displaced as the country's premier employer." The News also notes that the aircraft industry "could be wholly erased without any lasting harm to the economy," but that "loss of the auto industry, if that were conceivable, would be an historic catastrophe."

We certainly agree with the News that the auto industry occupies a vital role in the U. S. economy but fail to understand its provincial view that aviation is not vital to this country's present prosperity and future growth. We recommend that the Detroit News editorial writers do some investigating before they leap to the silly conclusion that this country can get along without any aviation.

They might ask hundreds of U. S. citizens rescued from floods, shipwrecks and enemy action by helicopters if aviation is necessary. They might ask millions who use air mail, air express and air freight. They might ask thousands of corporations, including General Motors Corp. and executives who own or use aircraft for business purposes. And they might ask the 33 million passengers who rode U. S. airlines last year if erasing aviation would make any difference.

Finally, they might take a long look at airpower in the Air Force, Army, Navy and Marines and ask if we would have any economy or, in fact, any country at all without the aircraft industry and its products.

UAC's Statesmanship

Another example of statesmanlike approach by an aircraft corporation management to a problem involving the survival of the free world can be found in an advertising program plugging NATO in European newspapers.

This program is sponsored by United Aircraft Corp. It germinated during a recent visit of UAC President H. M. Horner to Europe where he attended a briefing by General Alfred M. Gruenther, SHAPE commander, at which the point was made that recent research had revealed that between 75 and 80% of the people in the 13 NATO countries didn't even know what the initials signified. Obviously these people had not the faintest idea of what NATO is trying to do for them in protection against the menace of communist military aggression. At this same briefing, General Gruenther made the point that while American industry had been extraordinarily successful in telling its product story to world-wide consumers it seemed a pity that this same technique could not be applied effectively at a political level.

Horner took up the challenge and set his staff to work producing a six-page series of ads that are running in 25 newspapers in 17 key cities of the 13 NATO countries explaining the purpose, organization and problems of NATO. This series has been approved by SHAPE headquarters in Paris.

The United Aircraft Corp. NATO ad series is another fine example of how the maturing management of the aircraft industry is using its growing financial resources in the best public interest.

—Robert Hotz

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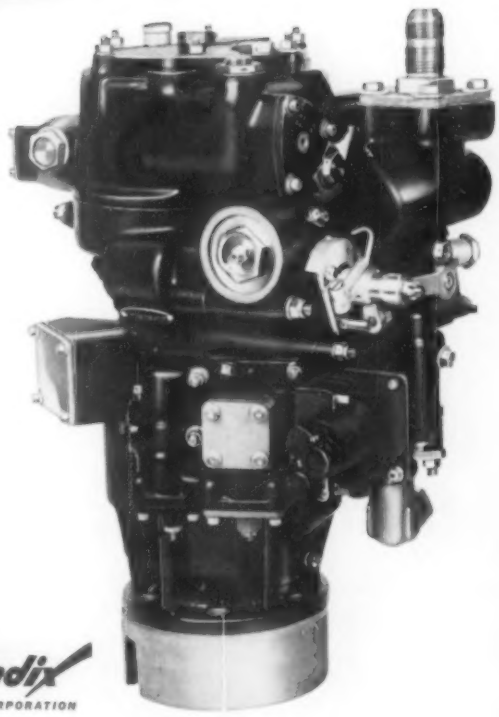

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